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THE CLADOCERA OF NEBRASKA*

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WITH FOUR PLATES

INTRODUCTION

In the fall of 1895 the writer began a study of the Cladocera of Nebraska; the work on this group has continued with increasing interest for a period of five years, with such results as may be found in this paper, which has been prepared in connection with a course of graduate study in the Department of Zoology in the University of Nebraska and accepted by the Faculty, June, 1900, as a thesis for the degree of Doctor of Philosophy.

Gratitude is due Dr. R. H. Wolcott and Miss Caroline E. Stringer for several bottles of material received from them, and the writer would express his most grateful acknowledgments to his friend Dr. H. B. Ward, of the University of Nebraska; for it was through his influence and kind personal guidance that the task has been pursued and finally completed.

METHODS

The material was obtained partly with the Birge net and partly by the use of a small plankton pump which was devised by the writer during the early part of his work, Fordyce (98). It has proved to be a very valuable piece of collecting apparatus as it enables one to collect in many places inaccessible to the ordinary net, and by means of it both the qualitative and quantitative value of the collections may be ascertained as well as the vertical distribution of the fauna.

The material is preserved partly in formalin, partly in alcohol and partly in a solution consisting of:

Glycerine	2 parts by vol.
Distilled water	3 parts by vol.
Glacial acetic acid	2 parts by vol.
Absolute alcohol	1 part by vol.

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* Studies from the Zoological Laboratory, The University of Nebraska, under the direction of Henry B. Ward, No. 42.

This latter solution, recommended for water mites by Koenike (91), allows both form and color to deteriorate, but prevents hardening of the tissues, rendering them more favorable for dissection, especially for external work. It has proved also to be a valuable solution for specimens designed for permanent mounting on slides. For the preservation of form and color, the formalin proved decidedly preferable.

Many methods of fixing, staining and mounting have been tried, but the best results are found in transferring from Koenike's solution to picro-sulphuric acid, washing in 70% alcohol, staining in Mayer's alcoholic cochineal, dehydrating, clearing and mounting in balsam.

HISTORICAL

Until a quarter of a century ago the Cladocera were practically unknown in this country and not till near the close of the preceding century did fresh water investigations yield sufficient data for a systematic treatise on these entomostraca even in the old world.

Jules Richard (94 and 96) gives a bibliography that contains a very extensive list of the literature showing what has been done on this group not only in Europe but in most other countries. It will, therefore, be needless in this article to refer to any literature aside from that concerning itself with the work done in our own country. S. I. Smith (74) in his Sketch of the Invertebrate Fauna of Lake Superior opens American literature on this subject. In this article Smith reports five species:

Eurycercus lamellatus Mueller.
Leptodora hyalina Lilljeborg.
Daphnia pulex De Geer.
Daphnia galeata Sars.
Daphnia pellucida Mueller.

There were no further contributions for several years when Chambers (77) reported five species one of which was new; in the order given, the first two were from Colorado, and the remaining three from Kentucky:

Chydorus sphaericus Mueller.
Daphnia brevicauda n. sp.
Daphnia pulex De Geer.
Daphnia mucronata Mueller.
Moina branchiata Jurine.

E. A. Birge (78) contributes his first list of thirty-eight species, largely from Madison, Wisconsin. This contribution is remarkable for the number of forms new to science, there being twenty new species, one new genus and one new variety, as indicated in the subjoined list:

Sida crystallina O. F. Mueller.
Daphnella exspinosa sp. nov.
Moina brachiata Jurine.
Ceriodaphnia dentata sp. nov.
Ceriodaphnia consors sp. nov.
Ceriodaphnia cristata sp. nov.
Simocephalus americanus sp. nov.
Simocephalus vetulus O. F. Mueller.
Scapholeberis mucronata (?) O. F. Mueller.
Scapholeberis nasuta sp. nov.
Daphnia pulex De Geer, var. denticulata, var. nov.
Daphnia levis sp. nov.
Lathonura rectirostris O. F. Mueller.
Macrothrix rosea Jurine.
Bosmina longirostris O. F. Mueller
Bosmina cornuta Jurine.
Eurycercus lamellatus O. F. Mueller.
Pleuroxus procurvus sp. nov.
Pleuroxus straminius sp. nov.
Pleuroxus insculptus sp. nov.
Pleuroxus denticulatus sp. nov.
Pleuroxus unidens sp. nov.
Pleuroxus hamatus sp. nov.
Pleuroxus acutirostris sp. nov.
Chydorus sphaericus O. F. Mueller.
Chydorus globosus Baird.
Crepidocercus setiger sp. nov.
Graptoleberis inermis sp. nov.
Alona angulata sp. nov.
Alona porrecta sp. nov.
Alona glacialis sp. nov.
Alona spinifera Schoedler.
Alona oblonga P. E. Mueller.
Alona tuberculata Kurz.
Alonopsis media sp. nov.
Acroperus leucocephalus Koch.
Camptocercus macrurus O. F. Mueller.
Polyphemus pediculus De Geer.

S. A. Forbes (78) lists among fish foods of the Illinois River seven species:

Leptodora hyalina Lillj.
Eurycercus lamellatus Mueller.
Bosmina sp. (?)
Daphnia angulata Say.
Ceriodaphnia angulata Forbes.
Daphnia pulex De Geer.
Daphnia galeata Sars.

C. L. Herrick (79) gives without reference to geographic distribution a few interesting notes on the genera *Daphnia*, *Sida*, *Ceriodaphnia*, *Polyphemus*, *Bosmina* and *Eurycercus*. A year later Birge (81) adds in his notes on the Crustacea of the Chicago Water Supply a full description of *Latona setifera* mentioning the points in which his specimen differs from the European species.

Herrick (82) describes the development of *Daphnia magna* and *D. pulex* and speaks of the importance of Cladocera as agencies in purifying stagnant waters; in his second article (82a) he deals with a new genus, *Lyncodaphnia*, giving a figure and description of the species *L. macrothroides*, his representative of this new genus.

In still another article (82b) Herrick reports among the crustacea of the fresh waters of Minnesota twenty-four forms; three of these, as indicated below, are new species, one is a new variety and two are undetermined:

Daphnella brachyura Liev.
Sida crystallina Mueller.
Moina rectirostris Jurine.
Daphnia pulex De Geer.
Daphnia sp. (?)
Scapholeberis mucronata Mueller.
Scapholeberis armata, var. (?) n.
Bosmina longirostris Mueller.
Bosmina cornuta Jurine.
Bosmina striata n. sp.
Macrothrix tenuicornis Kurz.
Hyocryptus spinifer n. sp.
Lyncodaphnia macrothroides Herrick.
Eurycercus lamellatus Mueller.
Leydigia quadrangularis Leydig.
Camptocercus macrurus Baird.
Camptocercus rotundus n. sp.
Acroperus sp. (?)
Pleuroxus procurvus Birge.
Pleuroxus unidens Birge.
Graptoleberis inermis Birge.
Crepidocercus setiger Birge.
Alona oblonga P. E. Mueller.
Polyphemus pediculus De Geer.

Somewhat later (84) Herrick produced an extensive and valuable article in which he gives a complete synopsis of the species known at that time in North America. This article is enriched by twenty-three plates and the addition of the following new forms:

Ceriodaphnia scitula n. sp.
Simocephalus rostratus n. sp.
Daphnia pulex, var. nasutus, var. n.
Daphnia minnehaha n. sp.
Daphnia magniceps n. sp.
Alona modsta n. sp.
Alona glacialis, var. tuberculata, var. n.
Alona glacialis, var. laevis, var. n.
Alonella pulchella n. sp.
Pleuroxus affinis n. sp.
Polyphemus stagnalis n. sp.

C. M. Vorce (81) lists from Lake Erie *Bosmina longirostris* Mueller and *Daphnia pulex* De Geer, and later (82) he reports from the same lake *Chydorus sphaericus* Mueller and an undetermined species of *Daphnia.*

L. M. Underwood (86) gives one of the most serviceable contributions in our literature; it is a list indicating the distribution of the Cladocera then known in the United States, with references to American and foreign literature bearing upon these species; his list embraces 137 species, distributed as follows:

ALABAMA

Pseudosida bidentata Herrick.
Moina rectirostris Baird.
Ceriodaphnia alabamensis Herrick.
Scapholeberis angulata Herrick.
Scapholeberis armata Herrick.
Simocephalus daphnoides Herrick.
Daphnia pulex De Geer
Leydigia quadrangularis Kurz.
Pleuroxus affinis Herrick.
Pleuroxus denticulatus Birge.
Pleuroxus hamatus Birge.
Pleuroxus unidens Birge.

COLORADO

Daphnia brevicauda Chambers.
Chydorus sphaericus Baird.

ILLINOIS

Daphnia hyalina Leydig.
Daphnia retrocurva Forbes.

KENTUCKY

Daphnia brevicauda Chambers.
Daphnia hyalina Leydig.
Chydorus sphaericus Baird.

MASSACHUSETTS

Sida crystallina Mueller.
Daphnella brachyura Baird.
Latona setifera Strauss.
Ceriodaphnia cristata Birge.
Daphnia pulex De Geer.
Bosmina cornuta Baird.
Bosmina longirostris Baird.
Acroperus leucocephalus Schoedler.
Camptocercus macrurus Baird.
Graptoleberis testudinaria Kurz.
Alona angulata Birge.
Alona glacialis Birge.
Alona parvula Herrick.
Alona porrecta Birge.
Alona spinifera Schoedler.
Alonella excisa Kurz.
Pleuroxus acutirostris Birge.
Pleuroxus denticulatus Birge.
Pleuroxus hamatus Birge.
Pleuroxus procurvus Birge.
Pleuroxus stramineus Birge.
Chydorus sphaericus Baird.
Polyphemus pediculus Linn.

MINNESOTA

Sida crystallina Mueller.
Daphnella brachyura Baird.
Moina rectirostris Baird.
Ceriodaphnia cristata Birge.
Ceriodaphnia laticaudata Mueller.
Ceriodaphnia parvula Herrick.
Ceriodaphnia scitula Herrick.
Scapholeberis americanus Birge.
Simocephalus vetulus Schoedler.
Daphnia dubia Herrick.
Daphnia galeata Sars.
Daphnia hyalina Leydig.
Daphnia kalbergensis Schoedler.
Daphnia magniceps Herrick.
Daphnia minnehaha Herrick.
Daphnia pulex De Geer.
Daphnia rosea Sars.
Bosmina cornuta Baird.
Bosmina longirostris Baird.
Bosmina striata Herrick.
Macrothrix pauper Herrick.
Macrothrix tenuicornis Kurz.
Lathonura rectirostris Lillj.
Lyncodaphnia macrothroides Herrick.
Ilyocryptus spinifer Herrick.
Eurycercus lamellatus Baird.
Camptocercus macrurus Baird.
Camptocercus rotundus Herrick.
Alonopsis latissima Kurz.
Alonopsis media Birge.
Leydigia acanthocercoides Kurz.
Graptoleberis testudinaria Kurz.
Crepidocercus setiger Birge.
Alona affinis Schoedler.
Alonella pulchella Herrick.
Alonella pygmaea Kurz.
Pleuroxus denticulatus Birge.
Pleuroxus procurvus Birge.
Chydorus caelatus Schoedler.
Chydorus globosus Baird.
Chydorus sphaericus Baird.
Monospilus dispar Sars.
Polyphemus pediculus De Geer.

MISSISSIPPI

Scapholoberis angulata Herrick.
Simocephalus americanus Birge.
Simocephalus rostrata Herrick.

PENNSYLVANIA

Daphnia abrupta Haldeman.
Daphnia reticulata Haldeman.

WISCONSIN

Daphnia crystallina Mueller.
Moina rectirostris Baird.
Ceriodaphnia consors Birge.
Ceriodaphnia cristata Birge.
Scapholeberis aurata Birge.
Simocephalus americanus Birge.
Simocephalus vetulus Schoedler.
Daphnia kerusses Cox.

Daphnia pulex Claus.
Bosmina longirostris Baird.
Macrothrix rosea Baird.
Acroperus leucocephalus Schoedler.
Camptocercus macrurus Baird.
Graptoleberis testudinaria Kurz.
Crepidocercus setiger Birge.
Alona oblonga Mueller.
Alona porrecta Birge.
Alona spinifera Schoedler.
Alonella excisa Kurz.
Pleuroxus denticulatus Birge.
Pleuroxus procurvus Birge.
Pleuroxus unidens Birge.
Chydorus globosus Baird.
Chydorus sphaericus Baird.

LAKE SUPERIOR

Daphnia galeata Sars.
Daphnia hyalina Leydig.
Daphnia pulex Claus.
Eurycercus lamellatus Baird.
Leptodora hyalina Lillj.

LAKE MICHIGAN

Sida crystallina Mueller.
Holopendium gibberum Zaddach.
Daphnia hyalina Leydig.
Camptocercus macrurus Baird.
Pleuroxus denticulatus Birge.
Chydorus sphaericus Baird.
Leptodora hyalina Lillj.
Latona setifera Strauss.

EASTERN UNITED STATES

Scapholeberis mucronata Schoedler.

SOUTHERN UNITED STATES

Daphnia angulata Say.
Daphnia rotundata Say.

Forbes (86) gives a full description of *Leptodora hyalina* caught at Chautauqua Lake, New York, and in other articles (88, 88a) in the reports of the Illinois State Laboratory of Natural History adds valuable notes on Cladocera among the foods of fresh water fishes.

C. S. Fellows (88) reports from Lake Chautauqua, New York, the following six forms:

Leptodora hyalina Lillj.
Daphnella brachyura Liev.
Chydorus sphaericus Mueller.
Bosmina longirostris Mueller.
Ceriodaphnia sp. (?)
Daphina sp. (?)

Forbes (90) gives a complete diagnosis of the new species *Chydorus rugulosus* and reports from Lake Superior the following sixteen species:

Polyphemus pediculus L.
Leptodora hyalina Lillj.
Eurycercus lamellatus O. F. M.
Acroperus leucocephalus Koch.
Alona sp. (?)
Pleuroxus procurvus (?) Birge.
Chydorus sphericus Baird.
Chydorus rugulosus n. sp.
Chydorus globosus Baird.
Bosmina longirostris O. F. M.
Scapholeberis mucronata O. F. M.
Daphnia retrocurva Forbes, var. intexta.
Daphnia laevis Birge.
Daphnella brachyura Lievin.
Sida crystallina O. F. M.
Holopedium gibberum Zaddach.

E. A. Birge (91) reports sixty-four species, representing the collections made from Madison, Wisconsin, since 1878, three of these as indicated in the following list being new to science:

Holopedium gibberum Zad.
Sida crystallina O. F. M.
Daphnella brachyura Liev.
Daphnella brandtiana Fisch.
Latona setifera O. F. M.
Latonopsis occidentalis sp. nov.
Moina brachiata Jur.
Moina sp. nov.
Simocephalus vetulus O. F. M.
Simocephalus serrulatus Koch.
Ceriodaphnia megops Sars.
Ceriodaphnia reticulata Jur.
Ceriodaphnia pulchella Sars.
Ceriodaphnia consors Birge.
Scapholeberis aurita Fisch.
Scapholeberis obtusa Schdl.
Scapholeberis mucronata O. F. M.
Daphnia pulex De Geer.
Daphnia schoedleri Sars.
Daphnia minnehaha Herrick.
Daphnia hyalina Leydig.
Daphnia kalbergensis Schoedler.
Daphnia kalbergensis, var. retrocurva Schdl.
Daphnia kalbergensis, var. retrocurva Forbes.
Lathonura rectirostris O. F. M.
Macrothrix rosea Jur.
Macrothrix laticornis Jur.
Drepanothrix dentata Euren.
Ophryoxus gracilis Sars.
Ilyocryptus sordidus Lieven.
Ilyocryptus longiremis Sars.
Bosmina longirostris O. F. M.
Bosmina longicornis Schoedler.
Bosmina cornuta Jur.
Bosmina bohemica Hellich. (?)
Eurycercus lamellatus O. F. M.
Leydigia quadrangularis Leydig.
Alona quadrangularis O. F. M.
Alona affinis Leydig.
Alona lineata Fischer.
Alona guttata Sars.
Alona costata Sars.
Alona tenuicaudis Sars.
Alona lepida sp. nov.
Graptoleberis testudinaria Fischer.
Dunhevedia (Crepidocercus) setiger Birge.
Pleuroxus trigonellus O. F. M.
Pleuroxus denticulatus Birge.
Pleuroxus gracilis Hudendorff, var. unidens Birge.
Pleuroxus exiguus Lillj.
Pleuroxus excisus Fischer.
Pleuroxus procurvatus Birge.
Chydorus sphaericus O. F. M.
Chydorus sphaericus, var. caelatus Schdl.
Chydorus sphaericus, var. punctatus Hellich.
Chydorus globosus Baird.
Alonopsis latissima Kurz.
Alonopsis media Birge.
Acroperus leucocephalus Koch.
Camptocercus macrurus O. F. M.
Camptocercus rectirostris Schdl.
Camptocercus biserratus Schdl.
Polyphemus pediculus De Geer.
Leptodora hyalina Lillj.

During the same year Vorce (91) gives a complete description of his new species *Daphnella tuckermanni.*

C. Turner (92 and 93) reports from Cincinnati, Ohio, the following fifteen species with references to American literature descriptive of these forms:

Sida crystallina Mueller.
Moina paradoxa Weismann.
Scapholeberis mucronata Mueller.
Simocephalus vetulus Mueller.
Daphnia pulex De Geer.
Alona porrecta Birge.
Alona glacialis Birge.
Alona intermedia Sars.
Pleuroxus denticulatus Birge.
Pleuroxus hamatus Birge.
Chydorus sphaericus Mueller.
Bosmina cornuta Jurine.
Camptocercus macrurus Mueller.
Leydigia quadrangularis Leydig.
Dunhevedia setiger Birge.

Forbes (93) reports among the fish foods from the Yellowstone National Park, Wyoming, and from the Flathead Region of Montana twenty-one species, among these there are, as shown in the list appended, four new species and one new variety:

Alona sp. (?)
Bosmina longirostris Mueller.
Ceriodaphnia reticulata Jur.
Chydorus sphaericus O. F. M.
Daphnella brachyura Liev.
Daphnia angulifera (?)
Daphnia arcuata n. sp.
Daphnia clathrata n. sp.
Daphnia dentata Mantile.
Daphnia dentifera n. sp.
Daphnia pulex De Geer.
Daphnia pulex, var. pulicaria n. var.
Daphnia schoedleri Sars.
Daphnia thorata n. sp.
Eurycercus lamellatus O. F. M.
Holopedium gibberum Zad.
Leptodora hyalina Lillj.
Macrothrix sp. (?)
Polyphemus pediculus De Geer.
Scapholeberis mucronata O. F. M.
Sida crystallina O. F. M.
Simocephalus vetulus O. F. M.

Birge (93) enlarges his list from Wisconsin to eighty-four species; the following twenty are not found in the list from Madison, Wisconsin (Birge, 91); among these, four, as indicated, are new:

Simocephalus exspinosus Koch.
Ceriodaphnia quadrangula Sars
Ceriodaphnia lacustris sp. nov.
Bunops scutifrons sp. nov.
Streblocerus serricaudatus Fischer.
Acantholeberis curvirostris O. F. M.
Alona falcata Sars.
Alonella rostrata Koch.
Monospilus tenuirostris Fischer.
Pleuroxus nanus Baird.
Pleuroxus hastatus Sars.
Anchistropus minor sp. nov.
Chydorus rugulosus Forbes.
Chydorus faviformis sp. nov.
Acroperus angustatus Sars.
Moina affinis Birge.
Moina flagellata Hudendorff.
Daphnia microcephala Sars.
Daphnia longiremis Sars.
Camptocercus biserratus Schdl.

Birge (94) reports from Lake St. Clair, Michigan, the following thirty-four species and varieties, none being new:

Holopedium gibberum Zad.
Sida crystallina O F. M.
Daphnella brachyura Liev.
Latona setifera O. F. M.
Daphnia pulex De Geer, var. pulicaria Forbes.
Daphnia hyalina Leyd.
Daphnia kahlbergensis Schdlr., var. retrocurva Forbes.
Daphnia kahlbergensis, var. intexta Forbes.
Simocephalus serrulatus Koch.
Simocephalus vetulus O. F. M.
Ceriodaphnia lacustris Birge.
Scapholeberis mucronata O. F. M.
Ilyocryptus longiremis Sars.
Ophryoxus gracilis Sars.
Bosmina longirostris O. F. M.
Bosmina longispina Leyd.
Eurycercus lamellatus O. F. M.
Camptocercus rectirostris Schdlr.
Acroperus leucocephalus Koch.
Alona lineata Fisch.
Alona guttata Sars.
Alona affinis Leyd.
Alona sp. (?)
Alonella rostrata Koch.
Graptoleberis testudinaria Fisch.
Monospilus tenuirostris Fisch.
Pleuroxus denticulatus Birge.
Pleuroxus procurvatus Birge.
Pleuroxus nanus Baird.
Pleuroxus gracilis Hud., var. unidens Birge.
Chydorus sphaericus O. F. M.
Chydorus globosus Baird.
Polyphemus pediculus De Geer.
Leptodora hyalina Lillj.

Birge (95-97) gives an extensive and invaluable article on the vertical distribution of Cladocera. L. S. Ross (96) furnishes preliminary notes on the Entomostraca of Iowa and reports the following twenty-five species:

Sida crystallina O. F. M.
Daphnella brachyura Liev.
Simocephalus vetulus O. F. M.
Simocephalus serrulatus Koch.
Ceriodaphnia reticulata Jur.
Ceriodaphnia consors Birge.
Ceriodaphnia lacustris Birge.
Scapholeberis mucronata O. F. M.
Scapholeberis obtusa Schdl.
Daphnia hyalina Leydig.
Daphnia kahlbergensis Schoedler.
Daphnia kahlbergensis, var. retrocurva Forbes.
Daphnia sp. (?)
Macrothrix laticornis Jur.
Ilyocryptus sordidus Lieven.
Eurycercus lamellatus O. F. M.
Alona sp. (?)
Dunhevedia setiger Birge.
Pleuroxus denticulatus Birge.
Pleuroxus procurvatus Birge.
Chydorus sphaericus O. F. M.
Chydorus globosus Baird.
Leydigia quadrangularis Leyd.
Camptocercus rectirostris Schdl.
Leptodora hyalina Lillj.

Next Herrick and Turner (95) produced their monograph on the Entomostraca of Minnesota. This is the most extensive American contribution to Cladoceran literature, aiming to give diagnoses of all species previously reported from the United States. These diagnoses are accompanied by forty-one full paged plates. The volume contains descriptions and figures of the new species, *Daphnia exilis, Daphnia minnesotensis, Macrothrix nova-mexicana* and numerous European forms not yet found in this country.

Two years later Ross (97) describes a new species, *Ceriodaphnia acanthinus,* and reports the following twenty-nine other known species and varieties, all from the province of Manitoba, Canada:

Simocephalus vetulus O. F. Mueller.
Simocephalus serrulatus Koch.
Scapholeberis angulata Herrick.
Scapholeberis mucronata O. F. Mueller.
Eurycercus lamellatus O. F. Mueller.
Alona costata Sars.
Daphnia pulex, var. pulicaria, Forbes.
Lathonura rectirostris O. F. Mueller.
Macrothrix laticornis Jurine.
Bunops scutifrons Birge.
Sida crystallina O. F. Mueller.
Ceriodaphnia reticulata Jurine.
Pleuroxus procurvus Birge.
Pleuroxus excisus Fischer.
Pleuroxus sp. (?)
Acroperus leucocephalus Koch.
Polyphemus pediculus Linn.
Dunhevedia setiger Birge.
Pleuroxus denticulatus Birge.
Chydorus globosus Baird.
Alonopsis latissima, var. media, Birge.
Bosmina longirostris O. F. Mueller.
Alona quadrangularis O. F. Mueller.
Camptocercus rectirostris Schoedler.
Daphnia pulex De Geer.
Ilyocryptus sp. (?)
Chydorus sphaericus O. F. Mueller.
Graptoleberis testudinaria, var. inermis, Birge.
Leptodora hyalina Lilljeborg.

In the same year Ross (97a) adds to his previous list from Iowa (Ross, 96) six species, making a total of thirty-one species from that state; one of these as shown below is new to science:

Daphnia pulex De Geer.
Daphnia hybus n. sp.
Bosmina longirostris O. F. Mueller.
Pleuroxus exiguus Lilljeborg.
Alona guttata Sars.
Graptoleberis testudinaria, var. inermis, Birge.

Most of the literature mentioned in the preceding pages is in the form of brief articles found in pamphlets or government reports difficult of access. Not only are many of these contributions unavailable, but examination shows that some of them contain errors; in many instances the diagnoses are indefinite and unaccompanied by figures, and in some cases even the figures furnished do not harmonize with the descriptions. Incomplete as this literature is it has yet proved invaluable to the writer in his attempt to add a little to the work done in this country on the Cladocera.

The author acknowledges his indebtedness to Jules Richard, whose excellent synopsis of the entire suborder, with the clear-cut treatise and accurate figures on the families Sididae, Holopedidae and Daphnidae, has proved indispensable.

DISTRIBUTION IN NEBRASKA.

The literature cited shows but little work done on the Cladocera west of the Mississippi River, and so far as the author can learn from but two of the states bordering on Nebraska, viz., Iowa and Colorado, are Cladocera reported as found among their plankton organisms. Nebraska, located in the center of a great continent and remote from all large bodies of water, has been regarded as a field unfavorable to an extensive or varied aquatic fauna; investigation, however, shows its waters comparatively rich in faunal life. The state presents a great diversity in topography, soils, water supply and general surface conditions that tend to modify the life within its borders. The surface slopes to the southeast, giving the rivers a corresponding direction. An average altitude of 5,000 feet at the west end of the state and 1,000 at the east end gives these rivers a rapid current. Besides six important rivers, there are more than one hundred surveyed lakes which, were it not for the entrance of other factors, would, under our favorable climatic conditions, doubtless give us a plankton of fair volume and variety; but the waters are rapidly picked up and transported from our borders by dry winds that almost constantly prevail. As a result, many of our lakes are but temporary, thus limiting the conditions of aquatic life.

The soil of Nebraska is pre-eminently sandy, the sand varying all the way from a coarse quality in the eastern part of the state to silt in the southwest. In the central portion the loose sand shifts about, constituting the great Sand Hill region. The soil contains but little clay; in the eastern section of the state the boulder clays form a fair per cent, while in the western portion the clays are rich in lime and other minerals, forming the Marl region.

The character of the soil divides the surface into an Eastern or Drift region, a Central or Sand Hill region, a Southern or Loess region and a Western or Marl region (see map, Pl. XXIV). Each of these four regions, diversified by elevation, rainfall, evaporation, soil, etc., is characterized by a faunal life more or less peculiar to itself. The rivers, turbid with eroded soils which are held in suspension, flow rapidly along their valleys and deposit by overflows numerous lakes and bayous; from these bodies of standing water the collections have all been taken, for Cladocera are unable to withstand the strong, silt-laden currents of our rivers. The material has been collected from fifty-eight different stations indicated in the map (Pl. XXV). These stations, as indicated, are widely separated and many of them difficult of access, in consequence of which one visit only has been made to some of these points, a fact much to be regretted as frequent visits to other stations reveal not only interesting instances of seasonal polymorphism, but such seasonal changes in species and even in genera as to make it clear that the only means by which one can investigate the complete fauna of a station is to study the results of numerous collections that extend well through the various seasons of the year.

The collections were made mainly in the summer and autumn months, although many stations have been visited as well in the winter and spring. Of the fifty-eight stations from which the material was collected, thirty-six are located in the Eastern or Drift region, eleven in the Loess region, six in the Sand Hill region and five in the Marl region. The following families of Cladocera have been found at these stations: Sididae, Daphnidae, Lyncodaphnidae, Bosminidae and Lynceidae. It is a remarkable fact that there have been found no representatives of either Holopedidae or Leptodoridae and that Lyncodaphnidae are found only at one station, while their near relatives, Lynceidae and Daphnidae, are quite generally distributed. The following table shows the distribution of the families at the various stations in the four regions of our state:

1. Eastern or Drift Region with 36 stations—
    - Sididae found in ....10 stations
    - Daphnidae found in............20 stations
    - Lyncodaphnidae found in....... 1 station
    - Bosminidae found in ....10 stations
    - Lynceidae found in.............19 stations
2. Southern or Loess Region with 11 stations—
    - Sididae found in............... 6 stations
    - Daphnidae found in............ 9 stations
    - Lyncodaphnidae .... absent
    - Bosminidae found in........... 2 stations
    - Lynceidae found in............ 3 stations
3. Central or Sand Hill Region with 6 stations—
    - Sididae .... absent
    - Daphnidae found in............ 3 stations
    - Lyncodaphnidae .... absent
    - Bosminidae .... absent
    - Lynceidae found in............. 4 stations
4. Western or Marl Region with 5 stations—
    - Sididae .... absent
    - Daphnidae found in............ 3 stations
    - Lyncodaphnidae .... absent
    - Bosminidae .... absent
    - Lynceidae found in............. 3 stations

It will be observed that the family Sididae is represented in sixteen of the fifty-eight stations, Lynceidae in twenty-nine, Daphnidae in thirty-five, Bosminidae in twelve and Lyncodaphnidae in only one; the cosmopolities, Daphnidae and Lynceidae, are found in all four regions, and these are the only families yet found in the regions designated as the Sand Hills and the Marl region. A reference to the subjoined table shows that there are comprised in Nebraska under these families seventeen genera and twenty-six species; the distribution of which so far as thus ascertained is given in the table, pp. 132, 133.

The twenty-six species in the following table are distributed as follows:

Sididae, 2.
Daphnidae, 8.
Lyncodaphnidae, 1.
Bosminidae, 3.
Lynceidae, 12.
Total of 26.

Of this number all are new to Nebraska and the following are new to science:

Daphnia parvula
Bosmina ornamenta.
Leydigia fimbriata.

Pleuroxus truncatus is new to the United States and the following are rare in this country:

Macrothrix tenuicornis Mueller.
Dunhevedia setiger Birge.
Bosmina obtusirostris Sars.
Daphnia curvirostris Eyl.
Chydorus rugulosus Forbes.

Unfortunately there is little opportunity for comparing the Cladocera of Nebraska with those of adjoining states, as literature contains little reference to work done on this group in these states. Ross has furnished thirtytwo species from Iowa and Chambers reports two species from Colorado as shown in previous pages, but there seems to have been nothing done on the group in other states bordering on ours.

Of the twenty-six species found thus far in Nebraska the following named twelve only, as shown in preceding pages, have been reported from Iowa:

Sida crystallina Mueller.
Diaphanosoma brandtianum Sars.
Daphnia pulex De Geer.
Scapholeberis mucronata Mueller.
Simocephalus vetulus Mueller.
Bosmina longirostris Mueller.
Eurycercus lamellatus Mueller.
Graptoleberis testudinaria Fischer.
Dunhevedia setiger Birge.
Pleuroxus procurvus Birge.
Pleuroxus denticulatus Birge.
Chydorus sphaericus Mueller.

The last named species has been reported by Chambers from Colorado; the remaining fourteen Nebraska species have not, as far as the author can learn, been found in any of the states bounding ours.

The map (Pl. XXV) shows that the central and western regions are limited in the number of species found. These regions are further marked by a plankton meager in volume, parallel with which is a phytoplankton not only deficient in quantity but made up of such forms as do not afford desirable food for Cladocera. There are good reasons for believing that this scarcity of the phytoplankton limits the variety of the

	1. Arapahoe, fish pond	2. Beaver City, near depot	3. Beaver City, n. mill dam, 2 m. w. of 2	4. Beaver City, mid. mill dam, 2 m. w. of 2	5. Bellevue, springs n. town	6. Bethany, 2 m. e. Lincoln	7. Blair, DeSoto Lake, 4 m. s. town	8. Blair, DeSoto Canyon, 3½ m. s. 7	9. Broken Bow, pool ½ m. n. town	10. Curtis, lake e. side near town	11. Curtis, lake west side near town	12. Curtis, Medicine Creek, 1½ m. w. of 10	13. Crawford, lake 2 m. s. town	14. Decatur, Betsey's Lake, 1 m. n. town	15. Decatur, Clear Lake, mid., 1 m. n. 14	16. Decatur, Clear Lake, w. side, 1 m. n. 14	17. Decatur, Circle Lake, e. side, 1½ m. n. 14	18. Decatur, Circle Lake, w. side	19. Decatur, Mud Lake, 1 m. n. 14	20. DeWitt, Big Blue Bayou, 1 m. e.	21. DeWitt, mill pond, 1 m. e.	22. Elmwood, pool s. town	23. Fremont, pond west town
SIDIDAE																							
1. Sida crystallina Mueller														X									
2. Diaphanosoma brandtianum Sars			X	X							X												X
DAPHNIDAE																							
3. Daphnia pulex De Geer										X	X	X	X		X						X		
4. Daphnia curvirostris Eyln.																	X						
5. Daphnia galeata Sars	X									X													
6. Daphnia parvula n. sp.	X																						
7. Ceriodaphnia scitula Herrick			X	X			X	X					X		X	X							
8. Scapholeberis mucronata Mueller																			X			X	
9. Simocephalus vetulus Mueller					X																		
10. Moina affinis Birge				X																			
BOSMINIDAE																							
11. Bosmina longirostris Mueller					X										X	X	X	X		X			
12. Bosmina obtusirostris Sars.												X		X							X		
13. Bosmina ornamenta n. sp.		X																					
LYNCODAPHNIDAE																							
14. Macrothrix tenuicornis Kurz																							
LYNCEIDAE																							
15. Eurycercus lamellatus Mueller																							
16. Camptocercus macrurus Mueller																			X				
17. Leydigia fimbriata n. sp.						X																	
18. Graptoleberis testudinaria Fisch																							
19. Dunhevedia setiger Birge.																							
20. Alona glacialis Birge															X	X							X
21. Alonella rostrata Koch																							
22. Pleuroxus procurvus Birge																							
23. Pleuroxus truncata Mueller																							
24. Pleuroxus denticulatus Birge																							
25. Chydorus rugulosus Forbes										X	X						X	X	X				
26. Chydorus sphaericus Mueller								X	X				X		X	X							X

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
24. Fort Robinson, 3 m. w. of 13							×		×																	
25. Havelock, Horseshoe Lake, 3 m. e.			×					×	×																	
26. Hastings, lake, 2 m. n.		×	×						×																	
27. Hastings, So. Br. Blue, 1½ m. n. 26		×							×																	
28. Indianola, Coon Cr., ½ m. s.		×	×																							
29. La Platte Lake, 10 m. s. 5		×																								
30. Lincoln, pool n. city			×					×																		
31. Marsland, Robb's Pond																										×
32. Marsland, Niobrara R.																									×	
33. Minden, Rodger's Pond																	×									
34. Monroe Canyon								×								×									×	
35. Minnechaduza Bayou, 1 m. n. of Valentine																										×
36. Nehawka, pools n. town																								×		
37. Neligh, pools near town		×																								
38. Ord, Bayou Dane Cr. n.									×																	
39. Rifle Range, springs near 5																										×
40. Rifle Range, Fish Pond		×						×												×	×					
41. Sterling, pond s. town			×				×																			
42. Santa Lake, 3 m. n. 44		×																								×
43. Stella, Willson Lake, 3 m. n.											×															
44. South Bend, fisheries		×		×								×						×						×		
45. St. Michael, lakes near town									×																	
46. Swan Lake, 25 m. s. O'Neill									×					×	×	×	×	×	×	×	×	×	×		×	
47. Tecumseh, bayou w. town									×																	×
48. Tekamah, 3 m. n. of town																										×
49. Thedford, pools n. depot																								×		×
50. Thedford, peat bogs							×																	×	×	×
51. Tobias, cistern			×																							
52. Tobias, pool 1 m. s. w. 51		×																								
53. University Place, 3 m. e.								×	×																	
54. Waverly, pools near town								×																		
55. Wayne, pools near town																									×	×
56. Wayne, Stringer's Lake e. 55																					×				×	×
57. Weeping Water, pools s. e. town		×																								
58. Weeping Water, creek 3 m. e. 57		×							×															×		

species in the zooplankton, for there is little here upon which Cladocera can feed, aside from *Chroococcus*, Diatoms and *Ceratium;* both of the latter because of their size and silicious shells are poor food, especially for young broods (Richard, 94). That this food supply is an important factor in limiting and determining the zooplankton is evident from the fact that wherever in these regions the conditions favor a continuous phytoplankton of good volume and variety the Cladocera are correspondingly abundant. This is well illustrated in comparing the two stations at Crawford and Curtis, both in dry districts.

The lake at Curtis has an elevation of one thousand meters and is about one thousand meters long and five hundred meters wide, with a depth of seven meters. It is fed by springs, well lighted and provided with an alluvium bottom that gives a rich growth of higher plants about the shore. All of the conditions favor an abundant growth of Cladoceran food in the form of infusoria and algae of several varieties. As a result the water teems with Cladocera, representing all the Nebraska families except the Lyncodaphnidae, including even the pelagic form *Diaphanosoma.* Crawford Lake in the Bad Lands resembles this lake in depth, size and favorable location for light; it is likewise spring fed, but its marl bottom and other physical conditions are evidently unfavorable to the maintenance of vegetable plankton, a fact noted by Ward (96) in his investigations in Pine Lake whose bottom and physical conditions are similar to those in Crawford Lake. Aside from *Oscillaria* and an occasional diatom this lake seems almost sterile. Here only *Daphnia pulex*, *Ceriodaphnia scitula* and *Chydorus sphaericus* were found and these rarely.

One fact which doubtless exerts a modifying influence over the life as found in these lakes ought to be mentioned here, viz., that while both lakes are spring fed and therefore permanent bodies of water, yet each has been enlarged by artificial means. The collections were made at Curtis eleven years after the lake had been thus enlarged and those at Crawford but two years after the enlargement of the lake.

The lakes in the Sand Hill and Marl regions have a very scanty vegetable plankton; a glance at the table of distribution shows that the zooplankton is limited mainly to the cosmopolite *Chydorus* which is the only strictly perennial species found thus far in the state. Its favorite food is *Chroococcus* which grows almost anywhere it finds moisture. The hardy Daphnidae are the only other general representatives of these regions and they are limited in number. Diatoms are found generally distributed here and these again are the preferable food of Daphnids. The peat bogs near Thedford depart from the conditions prevalent in most of the Sand Hill and Marl districts. Here the environmental conditions favor the development of phytoplankton. Cladocera are correspondingly abundant (see table).

It is in the Eastern or Drift region, where nearly all factors favor the development and maintenance of a varied vegetable plankton, that the greatest number and variety of Cladocera are found. The one factor interfering here is the salinity of the waters in some places. Thus the brackish water in the lakes and bayous along Salt Creek is plankton poor. While the greatest volume of plankton is found in the smaller spring-fed ponds, invariably the larger lakes yield a greater variety, provided they are deep and spring-fed so as to resist the vicissitudes of temperature. In such lakes the Cladocera seem to go through the same cycle of life year after year, although the year 1899 showed a marked departure from the standard of the preceding four years. In this year the plankton was reduced in volume and quality, some species having disappeared from localities where they were previously prevalent.

This scarcity was observed by investigators of all groups of aquatic fauna within the state. The explanation may lie in the fact that the winter of 1898-99 was one of the longest and severest that the state has known for years; on February 12 the temperature was —47° F. at Camp Clark; varying from this extreme to —35° F. in most parts of the state. Farmers and ice-men found lakes and ponds that rarely freeze more than a foot frozen to the bottom. It would seem plausible that the plankton was unable to resist this extreme temperature and that this accounts for the reduction in its volume and the disappearance of some forms.

The hauls in Clear Lake near Decatur show some evidence of a division of the fauna into littoral and pelagic zones; in this lake the shore catches yield large volumes of the genera *Chydorus*, *Bosmina*, *Alona* and *Ceriodaphnia*, while the center of the lake yields but few of these littoral forms, but it is rich in *Daphnia* and *Camptocercus*. Collections from other parts of the state indicate no differentiation into littoral and pelagic areas.

VERTICAL MIGRATION

Observation reveals a considerable variation in vertical distribution which seems dependent on the disposition of the vegetable plankton; for in those lakes where the food consists mainly of algae that float on the surface, the Cladocera accumulate near the surface, particularly at night; but in lakes where the principal foods are diatoms and *Ceratium* that have a more uniform distribution the zooplankton is found correspondingly disposed. In several instances collections were made at night-time. In these collections it was observed that the volume of the plankton, especially in the superficial and bottom strata, differed so widely from collections made at other periods of the day that it was determined to make a few observations on the effect of light on vertical distribution.

Birge (95-97) in his plankton studies on Lake Mendota observed that Cladocera migrate to the surface stratum soon after sundown and descend shortly before sunup. Blanc (99) made a series of observations on the vertical movement of the Cladocera and other Entomostraca in Lake Geneva (Switzerland), concluding that the maximal number in the upper stratum occurred at 4 A. M. when its volume was 25 times as great as it was at 4 P. M. Two and one-half miles distant from his home a small pond was selected in which the writer made observations for a period of one week. The pond is excellently adapted for such investigations, being 25 meters long, 7 wide and 3 deep. It is spring-fed and contains only one species of Cladocera, viz., *Leydigia fimbriata* n. sp., which is large, brilliantly colored and easily counted with the unaided eye. The material was obtained with the Birge net and plankton pump with practically the same results. Collections were made at each visit from the upper stratum (one-third of a meter below the surface) and from the lower stratum (on the bed of the pond); to give uniform results with the net, it was thrown out for each haul a distance of 15 meters; with its depth regulated by a float, and drawn ashore at the rate of one meter per second. The observations were made at 12 o'clock M., 4 P. M., 8 P. M., 12 P. M., 4 A. M. and 8 A. M. in clear weather with the following results:

Time of observation	Terms in % of maximum
4 A. M.	100
8 A. M.	16
12 M.	0
4 P. M.	33
8 P. M.	66
12 P. M.	66

In the lower stratum the maximum occurred at 4 P. M. when it was much larger than was the maximum of the upper stratum. The minimum of the lower stratum came at 4 A. M., the time of the maximum of the upper stratum. The *Copepoda* showed a somewhat similar migration in the upper strata but did not yield corresponding results in the lower; at no time was their volume in the upper stratum comparatively so low as that of *Leydigia;* they seem to confine themselves more uniformly to the middle and upper strata. Most Cladocera are negatively affected by light; these observations on the new species *Leydigia fimbriata* in its reactions to different intensities of light indicates that it too belongs to the list of such organisms.

TAXONOMY

The Cladocera are minute, fresh water entomostraca with a laterally compressed body lying more or less concealed within a carapace that takes the form of a bivalved shell. The second pair of antennae are biramose and adapted for locomotion. There are four to six pairs of thoracic limbs, or feet, mostly foliaceous and lobate. The head is distinct and furnished with only one eye.

The suborder Cladocera is divided into two great groups, Calyptomera and Gymnomera; in the former, the body and thoracic appendages are encased in a bivalved shell; in the latter, the carapace is rudimentary, giving little or no protection to the body.

SYNOPSIS OF THE FAMILIES *

A. Calyptomera.

I. Six pairs of similar, nonprehensile, foliaceous feet whose margins are fringed with hairs arranged like the teeth of a comb. *Ctenopoda.*

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* The synopsis of the families as here given departs but little from the one found in Richard, while that of the genera is in many cases a complete modification of that given by the French author.

1. Second pair of antennae biramose, with laterally compressed articulations furnished with numerous hairs. *Sididae.*

2. Second pair of antennae uniramose in the female (among the males the rudiment of a second ramus), subcylindrical, furnished with only three apical hairs; animal surrounded by a gelatinous envelope. *Holopedidae.*

II. Five or six pairs of feet, the anterior pair being prehensile with their laminae destitute of branchiae; the second pair of antennae with cylindrical articulations furnished with few hairs. *Anomopoda.*

1. Ventral ramus of the posterior antennae with three articulations, dorsal with four.

(a) Five pairs of feet, with a large interval between the last two pairs; intestine with two cephalic caeca. *Daphnidae.*

(b) Five or six pairs of equidistant feet.

1′. First pair of antennae in the female long, immobile, proboscis-like, with the sensorial hairs remote from apex; no cephalic caeca. *Bosminidae.*

2′. First pair of antennae in female long, mobile, with sensorial hairs apical; intestine simple or convolute. *Lyncodaphnidae.*

2. Second pair of antennae with three articulations in each ramus.

(a) Five or six pairs of equidistant feet; intestine circumvoluted. *Lynceidae.*

B. Gymnomera.

I. Feet bare, subcylindrical, all prehensile.

1. Four pairs of prehensile feet armed with strong claws provided with maxillary processes at the base. *Polyphemidae.*

2. Six pairs of simple feet without maxillary processes. *Leptodoridae.*

KEY TO THE GENERA OF SIDIDAE FOUND IN NEBRASKA

1. Second pair of antennae with three articulations in the dorsal ramus and two in the ventral. Rostrum distinct; numerous teeth on the post-abdomen. *Sida.*
2. Second pair of antennae with two articulations in the dorsal ramus and three in the ventral; no abdominal teeth. *Diaphanosoma.*

Sida crystallina O. F. Mueller

*Birge (78).

Herrick (79, 82, 84).

Herrick and Turner (95:147; Pl. 35, Figs. 13-15, and Pl. 37, Figs. 1, 2).

Among all the collections made in Nebraska during a period of five years but a single representative of this comparatively widely distributed species was found; this occurred among algae in the edge of Betsey's Lake, a large sheet of cold water near Decatur; the specimen is a large female measuring 2 mm. in length and 1 mm. in height. The body is elongato-quadrangular, separated from the large subquadrangular head by a distinct depression. The eye is located in the antero-ventral part of the head and is large, provided with numerous crystalline lenses well differentiated from the voluminous pigment. The first pair of antennae is cylindrical, with several coarse divergent sensorial hairs and with a tentacular hair much longer than the rest. The second pair of antennae is very strong, extending almost to the posterior margin of the shell; the basilar joint is robust, curving slightly ventrad, the biarticulate ventral ramus being furnished with fine apical plumose setae and a sharp spine on the ventro-apical part of the first articulation. The dorsal ramus is a third longer than the ventral, has three plumose setae on the second articulation and seven on the third. There are six pairs of feet well separated and armed with numerous long, stiff hairs arranged like the teeth of a comb. The ventral margin of the shell is ornamented with short, stiff hairs and terminates in a short caudo-ventral spine. The post-abdomen is conical, ending in slightly curved claws with four almost straight secondary teeth equal in length. On either side of the post-abdomen is a series of twenty marginal teeth. There are two biarticulate abdominal setae destitute of spinules. The intestine is without caeca and gradually increases in diameter anteriad.

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*Since full references to the literature on Cladocera are to be found in such standard European works as those of Richard and others, reference is made in this paper to American contributions only.

Diaphanosoma brandtianum Sars

Fig. 9, Pl. XXIII

Daphnella exspinosa Birge (78:3; Pl. II, Figs. 1-4).

Daphnella winchelli Herrick (79a).

Daphnella brachyura Herrick (84:21; Pl. Q 5, Figs. 11-16).

Daphnella brachyura Herrick and Turner (95:148; Pl. 26, Figs. 11-16).

Description of Female.—This is a comparatively small Cladoceron, the length being from 0.7 to 0.8 mm. The head is long, narrow, extending directly forward, measuring about one-third the total length of the animal; the dorsal margin is faintly convex. There is a distinct depression between the head and the thorax in distinction from *D. brandtianum* Sars in which the depression is very slight. The rounded anterior part of the head is somewhat truncate at the extremity and the lower margin presents a slight incurving just below and back of the eye; the portion from this point back to the body is slightly convex.

The carapace, as seen from the side, exhibits a rather homely outline: the dorsal margin is convex, the anterior three-fifths of the ventral margin is but slightly convex, while the posterior two-fifths is distinctly convex and armed by seven (and in some instances eight) sharp, faintly curved spines that point caudad. The interval between each two spines is filled by two to three irregular set smaller straight spines (Fig. 9). Herein our species departs from the description of *D. brandtianum* Sars which has six smaller spines in each interval. The lower portion of the posterior margin is ornamented by very fine, short hairs. The eye is large, approaching the anterior and lower margins of the head; the pigment matter is voluminous, the crystalline lenses large, few in number and, seen from the side, form seemingly only one circle. The antennae of the first pair are small, tapering gradually from the distal to the proximal end with the tentacular hair much longer than the others. The antennae of the second pair are robust and when flexed they extend almost to the posterior margin of the shell; the basilar joint is large, strong, curved slightly ventrad and nearly as long as the dorsal ramus; its length being 0.26 mm., and that of the dorsal ramus 0.28 mm.

The proximal joint of the dorsal ramus bears four biarticulate setae with a dorso-apical spine and the distal seven with a short apical spine on its dorsal side. The ventral ramus is about two-thirds as long as the dorsal; the proximal joint is very short, only about half as long as the distal, and in many specimens very indistinctly marked off. The middle joint is as long as the two extreme joints together and is furnished with a sharp spine on the ventral portion of the distal end. The terminal joint is furnished with four biarticulate setae, two of which are apical, the other two lateral, one attached near the middle of the dorsal margin and the other at the base of the ventral margin.

The post abdomen is small, armed with two gracefully curved terminal claws which have three slightly curved, nearly parallel secondary teeth near their base. The dorsal margin of the post abdomen is destitute of teeth; the abdominal setae are 0.3 mm. in length and emerge from a single nodular prominence. The feet are all furnished with suboval vesicular appendages.

In the first foot the branchial lamina is much narrower than in the rest.

Male.—The form agrees in general with that of the female. The average length of the male is about 0.2 mm. less than that of the female.

The antennae of the first pair are very much longer than those of the female; they are furnished with numerous coarse sensory hairs and a long curved, gradually attenuated flagellum with its margins densely ciliate. The second pair of antennae is comparatively longer than in the female; when flexed, they surpass the posterior margin of the carapace. The first foot is armed by a long, slender claw.

D. brandtianum is widely distributed over the state, being found in fifteen of the fifty-eight stations visited and in many of these stations it is abundant. It seems to preter well lighted, clear, cold water.

KEY TO THE GENERA OF DAPHNIDAE FOUND IN NEBRASKA

I. First pair of antennae in female small, inserted below the rostrum or on the posterior margin of the head.

A. Shell reticulated with small quadrate or polygonal areas.

1. Ventral margin regularly convex; the dorsal margin produced posteriad in an almost median line in the form of a spine or sharp point. The shell presents no posterior margin.

(a) Anterior antennae of female immobile. Head separated from the thorax by an obtuse depression or by none; anterior margin of the head with no sinus; rostrum distinct. Shell ornamented with quadrate or rhombic areas.

1. Pigment fleck present. *Daphnia.*

(b) Anterior antennae of female mobile; head separated from the thorax by a deep sinus; rostrum usually absent. Shell ornamented with pentagonal or hexagonal areas. *Ceriodaphnia.*

2. Ventral margin of shell almost straight, continued directly back, forming a spine or sharp point; a distinct posterior margin. *Scapholeberis.*

B. Shell ornamented with sub-parallel transverse lines. *Simocephalus.*

II. First pair of antennae in female long, mobile, inserted on both sides of the ventral margin of the head.

A. Pigment fleck absent, body bulky, fornix small. *Moina.*

Daphnia pulex De Geer

Daphnia minnehaha Herrick (84:57; Pl. K, Figs. 1, 2; Pl. D, Fig. 1, 2; Pl. U, Fig. 16).

Herrick and Turner (95:193).

Female.—The average length 1.4 mm.; height 1 mm. The body is laterally compressed, elongate with the ventral margin more convex than the dorsal. The spine is comparatively short in the specimen examined, the average length only 0.26 mm., and placed near the dorsal margin. The head is large, slightly depressed, anterior margin rounded, bulging slightly in front of the eye, with no sinus separating the head from the thorax. The antero-ventral side of the head is somewhat concave, the rostrum distinct and sinuate on the posterior side. The fornix is high: the margins of the posterior half of the body as well as the spine are formidably armed with stout, sharp spines that extend backward. The reticulation of the shell presents uniform quadrate areas. The eye is large, the pigment prominent, the crystalline lenses large, few in number, and considerably separated from one another. The pigment fleck is small.

The first pair of antennae is short with short rather stiff closely set sensorial hairs extending barely to the margin of the beak.

Second pair of antennae short and weak; the trunk slender; the dorsal ramus provided with four setae, three being apical and the fourth on the ventral side of the distal end of the third articulation. The ventral, or triarticulate ramus is longer than the dorsal and provided with five setae, three apical and one on the ventro-distal end of both the first and the second articulation. The setae are very sparingly plumose.

The post-abdomen is narrow, with its posterior margin armed with fourteen curved teeth gradually decreasing in length dorsad. The terminal claws are provided with four prominent secondary teeth and a lateral series of coarse cilia, increasing in size upward, ending finally in a comb of six slender teeth. The abdominal processes are more or less hairy, the first one very prominent, slightly falciform, curving anteriad; the second also falciform, curving posteriad; the third process is short, tooth-like. The caudal setae are short, measuring only 0.35 mm. in length. The males have an average length of 1 mm. The first pair of antennae is considerably longer than they are in the female, with the flagellum about as long as the antenna itself. The abdominal processes are short and blunt.

The species seems to resemble the variety *minnehaha* Herrick more closely than any other variety, although it differs from this in size, in the form of the rostrum, in the number of secondary teeth on the terminal claw and in the number of anal teeth. The material was collected from waters presenting widely differing environmental conditions; some specimens come from small shallow pools, others from large deep lakes and the finest specimens obtained were taken out of a cistern at Tobias where they are abundant in the fall of the year.

Daphnia parvula n. sp.

Figs. 2, 3, 4, Pl. XXII

This is a very small daphnid, the average length being 0.65 to 0.7 mm., height 0.4 mm. In general, the form agrees with *D. pulex* except in the marked concavity of the ventral side of the head and in the absence of secondary teeth on the terminal claw. In size and form of the post-abdomen, the animal bears a close resemblance to *D. longispina.* The valves present a broadly elliptical outline; the dorsal and ventral margins unite to form a very short caudal spine, which in many cases is little more than an obtuse angle, which is always located dorsad.

In most cases the spine and the margins of the valves are destitute of spinules; in some specimens a few scattering short ones were observed. The reticulation of the shell is so indistinct as to be invisible, except in a few specimens in which faint quadrate areas appear. There is no depression separating the head from the thorax. The head is large, representing about one-fourth the total length of the body and about one-half the depth of the valves; the anterior margin is convex and the ventral margin markedly concave. The rostrum is distinct, blunt and marked by a deep sinus on the postero-ventral side. (Fig. 2.) The eye is remote from the margin of the head, large, with crystalline lenses few and distinctly separated. (Fig. 3.) The first pair of antennae is short, with a brush of stiff sensorial hairs that extend a little below the extreme ventral point of the beak. The second pair of antennae when flexed extend but little beyond the middle of the valves. The apical end of the basilar joint as well as each articulation of the rami is furnished with short teeth. (Fig. 2.) The setae extend to the posterior edge of the carapace and are destitute of cilia.

The post-abdomen ends in slender gracefully curved claws provided with a lateral row of coarse cilia that gradually diminish in length as they approach the apex. There are ten anal teeth, of which the first is one-third the length of the terminal claw; the remaining nine gradually decrease in length and are recurved, the last tooth lying almost parallel with the margin of the post-abdomen. (Fig. 4.) The first abdominal prolongation is rather long and distinctly curved anteriad; the second is as long as the first and but slightly curved anteriad; the third process is about half as long as the second from which it is clearly separated. The gastric caeca are prominent and curved back. The male shows the ordinary modifications peculiar to the sex. The young male differs but little from the female; in the adults, the beak is more obtuse than that of the female; the flagellum is very short, being but little longer and thicker than the ordinary sensorial hairs. The abdominal prolongations are almost obsolete in the males. In other particulars the male resembles the female. These daphnids were found in abundance, with no other species except occasional Sididae, in a small fish pond on a cattle ranch two and a half miles southwest of Arapahoe; the pond is about 50 meters long by 25 meters wide with an average depth of 5 meters. The water is spring-fed, poorly lighted and filled with algae, Oscillaria being especially dominant.

Daphnia curvirostris Eylmann

Fig. 5, Pl. XXII.

Daphnia curvirostris Herrick and Turner (95:94).

Female.—Average length 1 mm., height 0.54 mm. The posterior half of the dorsal margin of the valves is nearly straight, while the anterior half continues the uniform curve of the head. The ventral margin is convex; the two margins reunite on the dorsal side in a short caudal spine whose length is about one-half that of the body. The ventral margin and the spine are armed with sharp thick spinules which gradually disappear anteriad on the dorsal margin. The valves exhibit well marked quadrate areas. In a very few specimens was there noticed a slight depression separating the head from the thorax; the head is large, representing about one-fourth the total length of the body and about three-fourths the depth of the valves. The anterior margin of the head is gradually rounded; the ventral margin is nearly straight; the beak is convex on its posterior side, well developed and often concealed by the valves. The eye is small, approaching closely the margin of the head; the crystalline lenses are comparatively small, numerous and thickly set.

The pigment fleck is small. The anterior antennae are prominent, extending a little beyond the extremity of the beak; the anterior sensorial hair is much coarser and longer than the rest, forming a sort of flagellum. The second pair of antennae extend back to the posterior third of the valves; they are slender and graceful, the setae being faintly plumose. The basal joint is slender and extends to the anterior margin of the head; a short spine appears on the dorso-apical portion of each articulation of the dorsal ramus.

The post-abdomen is rather short; the terminal claw provided with two ventral teeth and a comb of eight secondary teeth, of which the distal tooth is the longest, the others gradually decreasing upward. The recurved anal spines are eight or nine in number, beginning close to the base of the terminal claw; they decrease gradually in length. The abdominal processes are pretty well grown together, exhibiting in most cases an irregular outline; the first forms a nodular tooth-like process. In the male, the beak is more obtuse with the ventral edge slightly sinuous. The first pair of antennae is long, the basilar joint measuring 0.13 mm. and the flagellum 0.1 mm. There is a slight depression on the ventral side of the curved flagellum about one-fourth of the way up from the distal end giving the appearance of a partial break in the flagellum. (Fig. 5.) The sensorial hairs are short and few in number. Aside from these two features, the males are very similar to the females.

This form was found at South Bend and also in Circle Lake near Decatur; in both lakes the water is deep, cold and full of algae.

Daphnia galeata Sars

Daphnia galeata Smith (74:695).

Daphnia galeata Herrick (84 [*pro parte*]: 150; Pl. 61, Pl. U, Fig. 6).

This form was found in deep pools in the western part of Nebraska; one portion of the material was collected at Curtis, and the other at Arapahoe. The characters agree in the main with the description of Sars, yet the length of my specimens falls considerably below those described by Sars. None in my collection exceed a millimeter in length. The body is oval in outline, the ventral margin uniformly and markedly convex, the dorsal margin but slightly curved upward. The shell is but indistinctly reticulate. The two margins of the shell reunite dorso-caudad to form a spine whose length is equal to or exceeds two-thirds the total length of the body. The spine is armed by stout, sharp teeth which are continued forward on the posterior portion of the dorsal margin where they become much more slender. The posterior two-thirds of the ventral margin as well as the caudal portion are armed with short sharp teeth like those on the spine. The head is large without a sinus separating it from the thorax; the length of the head in my specimens scarcely exceeds one-fourth that of the body while its depth is equal to three-fourths the depth of the valves. The anterior margin is uniformly rounded, except at a point in front of and usually but slightly above the eye, where there appears a large angular tooth, terminating more or less sharply; the anterior part of the ventral margin is convex, while the posterior part is either straight or faintly concave. The beak is very obtuse. The fornix is high and prominent, the eye is medium in size, the crystalline lenses are well differentiated from the pigment and more numerous than indicated by Sars. The pigment fleck is small and placed a considerable distance directly back of the eye.

The first pair of antennae is short and difficult to see. The sensorial hairs are few and extend but little beyond the extreme margin of the beak. The second pair of antennae is medium in size, extending, when flexed, a little farther than the middle of the valves. The basilar joint is comparatively long and curved slightly ventrad. The post-abdomen is robust, terminating in long, sharp claws, ornamented with a series of densely set cilia. There are ten recurved anal teeth gradually diminishing in length dorsad. The first one is placed near the base of the terminal claw and is about one-third as long as the terminal claw. The anterior abdominal process is short and curved cephalad, the second is short and dentoid, the third is but a nodular protuberance. The abdominal setae are short and ciliated.

The males are about three-fourths as large as the females which they resemble very closely. The first pair of antennae differs but little from those of the female; they are but little longer and are not distinguished by the usually prominent flagellum, the flagellum here being little more than a thickened sensorial hair.

Ceriodaphnia scitula Herrick

Herrick (84:40).

Herrick and Turner (95:172; Pl. 42, Figs. 5 to 8; Pl. 44, Figs. 1, 2; Pl. 45, Fig. 1).

This species is found with *Simocephalus* in great abundance in the marshy plains of the peat bog region near Thedford, Nebraska. The water is clear, cold, and rarely exceeds a depth of one decimeter. The general outline is oval; the dorsal and ventral margins of the shell unite in a sharp caudo-dorsal point. The shell is ornamented with pentagonal areas. There is a marked depression separating the head from the thorax; the ventral margin is provided with a few short teeth, while the dorsal margin and the caudal point are smooth; the head is comparatively large, distinctly depressed, slightly concave above the eye, uniformly rounded on the ventral side and concave on the posterior side. The fornices are prominent; the eye medium in size; the pigment voluminous, and the crystalline lenses few and so poorly differentiated from the pigment as to be scarcely noticeable. The anterior pair of antennae are prominent, 0.2 mm. long, with a nodular prominence on the anterior side, about one-fourth the way up from the distal end from which there springs a stout spine whose length is equal to or greater than the stalk of the antennae. The sensorial hairs are coarse and granular in appearance. The second pair of antennae are rather strong; when flexed, they extend to the posterior third of the body; the trunk is long (0.15 mm.) and slightly curved ventrad, the ventral ramus is scarcely shorter than the stalk of the antenna; the basilar articulation extends to the middle of the third articulation of the dorsal ramus; the four biarticulate swimming setae are but feebly ciliated, and in many specimens the dorsal ramus has cilia on the dorsal margin of the second, third and fourth articulations.

The terminal claw is without secondary teeth, ornamented with a series of short cilia that extend along the inner face; the anal teeth are nine in number: the fifth, sixth, seventh, and eighth being longer and less curved than the others. The abdominal prolongations are merely swellings on the margin, except the anterior one, which is in the form of a short tooth-like process. The male resembles very much the female, the first pair of antennae being a little longer and marked by a much longer flagellum. Average measurements: length of female 0.8 mm., of the male 0.6 mm.; height of female 0.54 mm., of male 0.4 mm. First pair of antennae in female 0.2 mm., in the male 0.25 mm.; second pair of antennae 0.28 mm.

Scapholeberis mucronata Mueller

Daphnia mucronata Herrick and Turner (95:172; Pls. 43, Figs. 4 to 7; 45, Fig. 5).

This species agrees in the main with *D. mucronata* as described by Mueller; the average length of the female is 0.8 mm., height 0.55 mm. The shell shows distinct hexagonal areas. The posterior part of the dorsal margin is straight or slightly concave, uniting with the straight posterior margin in such a way as to form an obtuse angle. The ventral margin projects posteriad in the form of a sharp spine which is about one-sixth the total length of the body. The straight ventral margin is interrupted in front by a rounded prominence that projects ventrad; just back of this prominence the margin is slightly convex and armed with teeth, each perpendicular to the portion of the convexity from which it extends. From this convexity back to the spine are found short teeth extending posteriad. There is a small distinct sinus between the thorax and the head which is markedly prone; the anterior portion of the head is rounded and apparently nearly filled with the large eye. There is a marked concavity on the ventral side just back of the eye. The beak is long, ending obtusely, pointing obliquely downward and is usually more or less concealed by the valves. The crystalline lenses are few, large and seemingly buried in the voluminous pigment, only the outer margins of them are discernible. The fornices extend to the beak and are short but prominent.

The first pair of antennae are short and the sensorial hairs few and divergent. The second pair of antennae are weak; when flexed, they barely reach the middle of the shell. In form, they are of the usual daphnid type. The post-abdomen is short and truncate. The terminal claw is but slightly curved; its posterior face is provided with a series of very short teeth. The anal teeth are four in number and of nearly the same length, instead of rapidly decreasing in length as indicated in Mueller's description. They occupy the middle portion of the truncated margin of the post-abdomen. The broad pouch of many of the females contains from four to five eggs.

This species is found in several stations as indicated in the table of species and always in deep, clear water; no males are in the collections.

Simocephalus vetulus Mueller

Figs. 6, 7, Pl. XXII

Simocephalus vetulus Birge (78:84).

Simocephalus vetulus Herrick (84:46).

Simocephalus vetulus Herrick and Turner (95:178; Pls. 44, Fig. 7; 52, Figs. 6-9).

Simocephalus vetulus Harvey (94:395).

Female.—This species was found most abundantly with *Ceriodaphnia* in marshy low grounds in one of the peat bog regions of Nebraska near Thedford. The water spreads over the open prairie among the ferns which grow almost as abundantly as the grass. The water is clear, cold, and rarely exceeds a decimeter in depth. The species is found in small numbers in several other stations. The general form of the body is quadrate; the head is small and somewhat depressed. In most specimens there is a slight depression immediately above the eye. The ventral side of the head is variable in shape; in some cases there is a concavity under the eye back of which there is an angular projection. The eye, contrary to Harvey's description (94), does not approach very closely the margin of the head. It is rather large, the crystalline lenses numerous, closely set, yet distinct from the pigment. The first pair of antennae are short, fusiform and provided with a prominent bulb on the upper third of the anterior face, from which there emerges a spine whose length is about two-thirds that of the body of the antennae. I failed to find the circles of minute teeth described by Harvey as encircling the body of the antennae. On first examination, the sensorial hairs seemed to be arranged in two series, as is shown in Harvey's figures, but on closer examination under an immersion lens this effect is shown to be due to the fact that the basilar half of the hairs is granular while the distal half is hyaline. (Fig. 6.) The second pair of antennae are short, extending when flexed only to the middle of the valves. The apical end of the basilar joint as well as that of each of the articulations of the rami is ornamented with densely set cilia. The biarticulate swimming setae are plumose and about twice as long as the rami. The valves are marked by fine sub-parallel lines; the ventral margin is gradually curved to the ventro-posterior point, from which the margin continues upward in a nearly straight line till it unites with the dorsal margin to form an obtuse angle whose position is variable but lies usually on the dorsal side; the dorsal margin is slightly convex, there being a slight but distinct depression between the thorax and the head. The caudal prominence is armed by sharp teeth which are continued cephalad on the dorsal margin and ventrad on the caudal margin, gradually decreasing in size on the former but interspersed with smaller teeth on the latter. (Fig. 7.) The ventral margin of the shell is ornamented by long, slender, plumose setae which are inserted above the margin and extend to or below its free edge.

These setae are replaced at the postero-ventral portion of the shell by four or five thick slightly ciliated setae that take on the form of spines. (Fig. 7.) The post-abdomen is robust and terminates in a long, slender, curved claw destitute of secondary teeth, but adorned with a series of short cilia; the anal teeth are at the truncated end of the abdomen; the first three are long, stout and ciliated, the remaining seven or eight gradually diminish in length. There is a prominent hairy angle just back of these claws above which there is a concavity.

The caudal setae are sparsely plumose and emerge from a single nodule which is found in a depression of the posterior face. But one abdominal process is prominent; this is dentoid and projects anteriad. The average length of the female is 1.6 mm., height 1 mm.; of the male 1 mm., height 0.7 mm. In my collection I found but few males, which differ from the females only in their smaller size and the greater length of the first pair of antennae; they resemble the young females so closely as to make it difficult to distinguish them.

Moina affinis Birge

Fig. 8, Pl. XXIII

Moina affinis Birge (93:290; Pl. 10, Figs. 1, 3, 5, 7, 8, 12, 13, 14).

I have been in doubt as to whether this cladoceron is more closely allied to the European species *M. rectirostris* Jurine, to *M. propinqua* Sars of Australia or to *M. affinis* Birge of the United States. On the whole it agrees more generally with the latter, from which it differs, however, in several details. The general outline of the body is about the same as Birge's species, but the head is more prolonged and decidedly more depressed. I find the same characteristic depression above the eye and the absence of the angle on the postero-ventral side of the head. The eye is large, the crystalline lenses numerous, oval in form and clearly differentiated from the pigment. The eye is more remote from the margin of the head than is indicated by Birge. The first pair of antennae in the female corresponds exactly to Birge's description, but in the male my animal presents notable variations; in the first place, I find but one curve, while *M. affinis* Birge shows a double curve; my form is more slender and graceful and has but a single sensory hair on the anterior margin, which is farther from the proximal end than Birge indicates. (Fig. 8.)

The distal end shows no variation, there being four curved claws or hooks near the end, on the most apical portion of which appear a few coarse sensory hairs. The second pair of antennae are comparatively strong; the basilar joint is robust, gradually decreasing in size from the proximal to the distal end which bears between the rami a long spine. A sharp spine appears on the dorsal side of the apical end of the rami; similar spines are often found on the dorso-apical portion of most other articulations.

The post-abdomen is long and slender, gradually decreasing in size to the claw, with the exception of a swelling on the posterior side just below the middle. The abdominal prolongations are scarcely noticeable, except the anterior one, which is a short nodule. The abdominal setae emerge from a common protuberance. The anal teeth form a lateral series, beginning with a long, smooth bident near the base of the terminal claw and decrease gradually upward. These teeth, except the bident, are serrated and thick at the base; their number is nine.

The terminal claw is beautifully curved and ornamented by a series of coarse cilia that gradually increase in size toward the base where they approach the appearance of very fine secondary teeth. The base of the terminal claw is provided on its anterior face with a brush of coarse hairs. The valves are sculptured with lines crossing each other in an irregular way. The ventral margin is densely ciliate.

Measurements of average specimens

Female—Length 0.6 to 0.7 mm., height 0.33 to 0.45 mm.

Male—Length 0.5 mm., height 0.3 mm.

Length of first pair of antennae in the male 0.3 mm.

This species was found abundantly in a large mill pond two miles west of Beaver City. The water is clear, cold, well lighted and contains few algae. The average depth of the pond is about 1½ meters.

CHARACTERS OF THE GENUS BOSMINIDAE FOUND IN NEBRASKA

First pair of antennae immobile, continuing the rostrum into a proboscis-like prolongation with the sensorial hairs remote from the apex. Pigment fleck and caeca absent. *Bosmina.*

Bosmina obtusirostris Sars

Bosmina obtusirostris Birge (93:300-1; Pl. 12, Figs. 10, 11).

Female.—Length 0.56 mm.; height, 0.4 mm.

The dorsal margin, head, and first pair of antennae, which seem to be an attenuated prolongation of the head, form an almost perfect semicircle. The protuberance in front of the eye is not so marked as indicated by Sars in his description. The shell is marked by lines parallel to the dorsal margin; the ventral margin is strongly convex anteriad and slightly concave posteriad, uniting with the posterior margin to form a short straight spine that is directed obliquely downward. There are three teeth on the dorsal side of this spine. The eye is small and remote from the margin of the head; the crystalline lenses are distinctly differentiated from the pigment. The first pair of antennae is but slightly curved and shows about ten segments and a sharp spine about one-fourth the way down from the base. The sensory hair is located on the antero-ventral side of the head just above the attachment of the first pair of antennae.

The basilar joint of the second pair of antennae extends when projected forward almost to the anterior part of the head. The dorsal and ventral rami are about equal in length and both composed of very short articulations. The swimming setae are arranged after the daphnid type. The post-abdomen is comparatively large, truncate at the apex and armed with six to ten small slender anal spines arranged in groups of two; the terminal claw is provided with seven secondary teeth of equal length. I find no males in my collection. This species seems to be rare in this country. Miss H. Merrill (Birge, 93:300) collected it near Woods Holl, Mass., Sars found it in Norway, Richard in Lapland, De Guerne and Richard report it from Siberia and Poppe and Richard report it as probably occurring in China. My specimens agree so generally with the descriptions and figures of these collectors that I do not hesitate to put it under the name of this rather rare species. The material was collected in spring-fed lakes at Curtis, Decatur, South Bend and Havelock.

Bosmina ornamenta n. sp.

Fig. 1, Pl. XXII, and Fig. 10, Pl. XXIII

This species was found in abundance and alone in a deep pool near Beaver City. The pool is located in a canyon, is cool and comparatively clear, containing Dinoflagellata (*Ceratium*) in great numbers, but no algae seem to be present. The general outline bears a close resemblance to *Bosmina cornuta* Jurine, but differs in having its greatest height in the anterior third of the body and in having the caudo-ventral spine shorter and directed obliquely downward. The shell is reticulated by small pentagonal and hexagonal areas on the lower side; on the upper these areas are elongate and extend lengthwise; in the middle of the shell the two forms of markings gradually shade into each other. (Fig. 1.) The head represents one-third of the total length of the body and two-thirds of its total depth; it is slightly protuberant in front of and a little above the eye. The first pair of antennae is long and so curved at their lower end as to point caudad. Its anterior margin shows slight elevations at the segments, of which there are eleven to thirteen. The sensory hairs are divergent and emerge from a tooth-like prominence situated on the anterior face about one-half of the way down from the base to the apex. The flagellum is fixed to a cylindrical prominence located just above the attachment of the beak-like antennae. The labrum is prominent; the eye is large and remote from the lower side of the head; the crystalline lenses are well separated from each other and from the voluminous pigment.

The second pair of antennae is short and thick; when projected forward, they surpass but little the anterior margin of the head. The basilar joint is robust and about twice as long as the rami; its dorsal margin is longer than the ventral, making an oblique articulation with the rami, which are composed of very short articulations, the diameter of each being considerably less than its predecessor; the dorsal or four-jointed ramus exceeds the triarticulate ramus by half the length of the apical joint; the number and arrangement of the sensorial hairs follow the usual type of the family. The ventral margin of the shell is convex in front and with the caudo-ventral spine forms a faint concavity in the region of the posterior third. The convex portion is furnished with several long, coarse hairs. The post-abdomen presents one of the most beautiful patterns found in the sub-order: in form it is rectangular; the terminal claw represents nearly one-third the total length; the secondary teeth begin at the extremity of the basal half of the claw and point downwards, the first two or three being long, slender and parallel with each other; the remaining members of the series gradually diminish in size dorsad till the comb ends above the base of the terminal claw. The apical half of the claw is serrate, the teeth are cylindrical, and project upward.

There are three small anal spines at the postero-apical point and numerous triad groups of hairs scattered along the posterior margin. The sides of the post-abdomen are ornamented with artistically arranged, short cilia, usually in groups of four. (Fig. 10.) The caudal setae are short, curved downward and fixed in a slight depression, above which several short spines appear on the posterior margin. The dorsal margin exhibits no abdominal prolongations.

Males are rare in my collection and show few distinguishing characteristics, except the presence of the copulatory hook on the first pair of feet. The average length of the animal is 0.36 mm., height 0.28 mm., length of post-abdomen 0.1 mm., terminal claw 0.033 mm., length of first pair of antennae 0.1 mm.

Bosmina longirostris Mueller

Bosmina longirostris Birge (78:91).

Bosmina longirostris Herrick (82:244).

Bosmina longirostris Herrick and Turner (95:207; Pl. 45, Fig. 2; Pl. 65, Fig. 2).

This form is identical with Mueller's species and is found abundantly in a small lake on Salt Creek near Havelock. The general form is oval; the posterior margin is slightly concave, the caudo-ventral spine is long and directed horizontally backwards. The greatest height is in a line passing through the middle of the body; the shell is reticulated by large hexagonal areas. The first pair of antennae is less curved than they are in *Bosmina ornamenta* and the second pair of antennae more slender. The post-abdomen is short, thick, with no anal teeth and the terminal claw is without secondary teeth, there being simply a series of cilia. The species is so familiar as to need no further description.

OUTLINE OF GENUS OF LYNCODAPHNIDAE FOUND IN NEBRASKA

Body oval, ending posteriad in an obtuse angle; head short and thick; ventral ramus with the swimming setae of the first and second joints large and armed with spines. *Macrothrix.*

Macrothrix tenuicornis Kurz

Macrothrix tenuicornis Herrick (82:245).

Macrothrix tenuicornis Herrick (84:70).

Macrothrix tenuicornis Herrick and Turner (95:214; Pls. 54, Figs. 5 to 8; 56, Figs. 1, 3, 12, 20).

Description of Female.—The outline of the shell resembles that of *Daphnia;* the dorsal and ventral margins, both of which are convex, unite to form an obtuse angle varying in position but always lying above the axis of the body. The ventral margin is provided with long, irregularly curved spines, between each two of which may be seen from two to three sharp teeth. This margin is further marked by a series of long, dense cilia which are attached above the margin extending to or beyond it. There is a slight sinus between the head and thorax; the head represents almost one-third the total length of the body and its depth equals about two-thirds the greatest depth of the shell. The lower anterior portion of the head is somewhat concave; immediately below this concavity is the blunt beak to which the first pair of antennae is attached; the head is produced ventro-posteriad into a prominent angle. The eye is medium in size with distinct lenses; the pigment fleck is prominent and located near the lower margin.

The first pair of antennae is long and shaped like the Italic letter *f*. There is a stout, sharp spine at the antero-distal end and a short one on the postero-distal end; other short spines are found scattered irregularly over the antennae. The sensorial hairs are few in number and coarse. The second pair of antennae is short and very spinulose. The basilar joint is robust, distinctly curved ventrad and armed here and there with spines. The rami are equal in length; there are numerous lateral spines on the upper side of the dorsal ramus and a few on the dorsal side of the ventral ramus. The distal end of each articulation is furnished with short teeth. The swimming setae are triarticulate, the middle articulation being very short. Each ramus is furnished with three apical hairs, the dorsal two in each case being furnished with a sharp spine at the first joint, pointing dorsad; the basal articulations of these setae are spinulose. Each ramus is furnished with a long dorso-apical spine. The seta extending from the distal end of the first point of the ventral ramus is very coarse, greatly enlarged at its base and armed with numerous prominent spines. The post-abdomen is short, terminating in short, thick, curved claws which have a nodular swelling at the base; there are no secondary teeth on the claws. The posterior margin has a prominent convexity just above the claws; the entire posterior margin is armed with sharp teeth; just inside of these teeth the surface is densely ciliate, particularly toward the distal end.

The caudal setae are short and almost destitute of cilia; the broad pouch contains three to four eggs. Average measurements among the females: length 0.66 mm., height 0.4 mm.; rami 0.16 mm., basilar joint 0.196 mm., elongated seta 0.45 mm., apical setae 0.32 mm., first pair of antennae 0.12 mm. The male differs but little in size and form from the female; the only marked difference lies in the first pair of antennae, which are longer by one-third and straighter than they are in the female and marked by apical teeth in connection with the long, coarse sensorial hairs. There are also two sharp spines on the posterior side a little above the end instead of the apical spines as in the female. This species has not, as far as I can learn, been before reported in this country except in Minnesota. It is abundant in Swan Lake, Holt County. The lake is about seven miles long and has an average depth of three meters. The water is filled with algae, is well lighted and cold.

KEY TO THE GENERA OF LYNCEIDAE FOUND IN NEBRASKA

General characters intermediate between Lyncodaphnidae and Lynceidae.

Intestine of the daphnid type. *Eurycercus.*

Post-abdomen large, with posterior margin swollen into a semicircle and armed with numerous long spines. Second pair of antennae with long sharp spines. *Leydigia.*

Shell elongate, provided with one to several minute teeth at the ventro-caudal angle. Head and back ridged. Post-abdomen very long and slender; terminal claw long and armed with a single secondary tooth. *Camptocercus.*

Head with a proboscis-like extension curved either forward or backward. Posterior margin of the shell armed with one to many teeth. Post-abdomen concave at distal end: terminal claw with two secondary teeth. *Pleuroxus.*

Shell rectangular, sculptured with longitudinal lines; head long and slender: post-abdomen subrectangular and armed on either side with two series of oval teeth. *Alona.*

Shell rectangular, head long, thick and directed horizontally forward; caudo-ventral angle armed with two teeth. Post-abdomen diminishing in size toward distal end and curved ventrad. *Graptoleberis.*

Characters intermediate between Pleuroxus and Alona. *Alonella.*

Shell globose, head slender, beak curved back close to valves; intestine circumbolute; prominent anal caecum. *Chydorus.*

Eurycercus lamellatus O. F. Mueller

Eurycercus lamellatus Smith (74:696).

Eurycercus lamellatus Birge (78:92).

Eurycercus lamellatus Herrick (82:248; 84:80).

Eurycercus lamellatus Herrick and Turner (95:226,Pls. 46, Figs. 7, 8; 51, Fig. 6; 60, Figs. 5, 6; 62, Fig. 19).

This is a very large Cladoceron, attaining an average length of 1.8 mm. It is evidently a conecting link between the *Lyncodaphnidae* and the *Lynceidae* as the intestine has no convolution and is provided with anterior caeca. The dorsal margin is nearly straight in its posterior half. The head is contained three times in the length of the valves and approximately three times in the depth; it is directed horizontally forward, terminating in a blunt beak which extends obliquely downward; the head conforms in general to the Lynceid type. The eye is large and resembles very much the daphnid eye. The lenses are few, prominent and separated from each other. The pigment fleck is small and located about one-third of the way down from the eye to the beak. The first pair of antennae is long (averaging 0.16 mm.), somewhat wedge shaped and curved anteriad at the basal end; the apical end is armed with long, sharp teeth, which are about one-third as long as the coarse, hyaline sensorial hairs. The second pair of antennae is built on the daphnid type and is short and weak with the basilar joint small and curved forward into an elbow. The basal joint of the dorsal ramus is short and the second joint is as long as the third and fourth combined; the dorsal ramus extends to the middle of the distal joint of the ventral ramus; in this latter ramus the basal joint is equal in length to the second and third together. The swimming setae are biarticulate, strong and plumose; the basal articulation is one-half as long as the distal; the conformity to the Lynceid type is broken in the dorsal ramus by the absence of the lateral seta. The dorso-apical end of the basilar joint of the antenna, of the second and fourth articulations of the dorsal ramus, and the distal articulation of the ventral ramus are each furnished with a long, stout, sharp spine. The apical end of each articulation is armed with short teeth; there are also several teeth on the ventral margin of the first articulation of the dorsal ramus.

The ventral margin of the shell is convex, being deepest in the anterior half; this margin is hairy. The posterior margin is rounding and ornamented with very fine teeth. The post-abdomen is very large and rectangular in form with both the anterior and posterior margins convex; the posterior margin is armed with very beautiful saw-like teeth which decrease in length dorsad. The tooth on the postero-apical end is about twice as long as the others; the distal end is concave, the terminal claw long (average length 0.18 mm.) and straight with its posterior face densely ciliate. The base is armed by a large, sharp secondary tooth, and beginning at the base of the claw there are two series of distal teeth which extend to the middle of the concavity. These teeth are long at the base of the claw and decrease gradually posteriad; this species is rare in Nebraska; a few specimens only are in my collections from Swan Lake. No males are found.

Camptocercus macrurus Mueller

Camptocercus macrurus Birge (91:395).

Camptocercus macrurus Herrick and Turner (95:229; Pl. 61, Figs. 10, 10a).

The body as seen from the side is elongate and elliptical with the anterior part of the shell emphasized; the dorsal margin is markedly convex, the curve continuing uniformly to the beak. The anterior fourth of the ventral margin is convex, just back of which there is a slight concavity; the posterior half of the margin curves upward to join the rounded caudal margin; at the caudo-ventral curve are found two or three teeth pointing dorsad. The shell is distinctly ornamented with parallel longitudinal striae. The anterior half of the ventral margin is provided with coarse cilia which grow gradually shorter posteriad. The head is large and directed obliquely downward at an angle of about 45° with the axis of the body; the beak is blunt, the postero-ventral margin of the head is slighted excavated in its lower half and concave in the upper half. The eye is small and placed back of the center of the head; the crystalline lenses are large, few and partly hidden by the pigment. The eye spot is smaller than the eye and located about half way down from the eye to the beak. The first pair of antennae is long, curved anteriad at the proximal end and slightly tapering to the apex, which has an expanded margin; the sensorial hairs are long, stiff and divergent. I have failed to find the elongate terminal seta described by Mueller. The flagellum emerges from the posterior side near the middle of the antenna. The second pair of antennae is very weak; when extended downward they reach but little beyond the ventral margin of the shell; they conform to the usual Lynceid type. The post-abdomen is very long and slender and tapers toward the apex; the terminal claw is likewise long and slender. It is nearly straight and armed at the base by a single large secondary tooth which is ciliate; it is further armed with a series of teeth that gradually increase in size from the base to the middle of the claw where they terminate.

There are sixteen to eighteen anal teeth which are thick at the base and serrate on their dorsal side; the post-abdomen is ornamented laterally by numerous groups of short, fine cilia. The intestine is circumvolute and provided with a small anal caecum. The average length of the female is 0.8 mm., height 0.46 mm., the post-abdomen is 0.28 mm. long, the terminal claw 0.12 mm. long and the basal secondary tooth 20 microns in length. I found but few males; their body is more slender and the beak more blunt. The post-abdomen is also more slender; the specimens are numerous in Swan Lake, Holt County, Nebraska.

Leydigia fimbriata n. sp.

Figs. 11, 12, 13, 14, Pl. XXIII

Female.—The outline of this species differs from the described forms of *Leydigia* in having the shell almost elliptical instead of ovate, with the larger end placed anteriad. The dorsal margin of the head is a continuation of the uniform curve of the upper part of the valves. The head is long and thick, the anterior half of the ventral margin is concave while the posterior half is distinctly convex. (Fig. 11.) The labrum is very prominent, extending ventrad almost as far as the beak. The eye is small with the lenses completely buried in the pigment. The pigment fleck is larger than the eye and is diamond shaped. (Fig. 12.) The first pair antennae is long and tapers toward the distal end, which is supplied with several fine sensory hairs. The second pair of antennae is short and presents a stunted appearance. When flexed they scarcely reach the middle of the shell. The basilar joint is stout and armed by numerous spines; its dorso-apical end, as well as those of the first and second articulations of the dorsal ramus, are armed by four strong, sharp divergent spines. The ventral ramus exceeds the dorsal ramus in length. Its basal joint is robust and presents a prominent swelling near the dorsal side of the basilar end. (Fig. 13.) A long spine appears on its distal end and a similar one marks the distal end of the first articulation of the dorsal ramus. There are three apical, biarticulate swimming setae and a dorso-apical spine on the third joint of each ramus; a short biarticulate seta emerges from the second joint of the dorsal ramus. There are thus seven setae in our specimen instead of eight as in the descriptions of Kurz. The shell is distinctly marked with large stipples or dots. The ventral margin is furnished with long, coarse setae, which curve posteriad.

The post-abdomen is enormously large and curved somewhat like the hind limb of a quadruped, maintaining nearly the same diameter throughout its length. Its posterior margin is not so bulging as *Leydigia quadrangularis* Leydig. This margin is armed on either side with a row of long, sharp, slightly curved spines appearing in groups of three or four, two or three long ones and one shorter; the spines in each group are markedly divergent and gradually grow shorter dorsad while the number of spines is found to increase in each group. Further in from the dorsal margin appears another series of spines which are in the form of very coarse hairs which are arranged in a line instead of groups; these coarse hairs fall over the sides of the margin, in some cases almost completely hiding the surface of the post-abdomen. (Fig. 14.) The anal setae are short, plumose and emerge from a single nodule, a short distance above which is another protuberance that bears a short sharp spine which is curved ventrad; the entire dorsal margin is furnished more or less with hairs. The terminal claw is long and nearly straight; a few setae appear at the base on the anterior face, while the posterior is marked on the proximal half by a series of setae that increase in length distad, and at its base is found a single long, secondary tooth. The intestine is convoluted and without caeca; the brood pouch never contains more than one egg.

Average measurements: length 0.55 mm., height 0.4 mm. Length of second pair of antennae 0.1 mm.

Post-abdomen: length 0.4 mm., width 01. mm. Length of terminal claw 0.1 mm.

The males are about three-fourths as large as the females and are characterized by a flagellum on the first pair of antennae and by a narrow post-abdomen. This species is found abundantly in Rodger's fish pond one mile west of Minden, at Bethany and occasionally in Swan Lake, Holt County; in the latter two stations the water is comparatively warm and contains but few algae, while in the first the water is cold and well supplied with algae.

Pleuroxus procurvus Birge

Pleuroxus procurvus Birge (78:92; Pl. 1, Figs. 19, 20).
Pleuroxus procurvus Herrick (82:250; 84:113).

Pleuroxus procurvus Herrick and Turner (95:258; Pl. 61, Figs. 3, 4).

This is a very small animal: Birge gives 0.4 mm. to 0.5 mm. as the average length, but in my collection I find the average length to be only 0.35 to 0.4 mm. and the height 0.24 mm. The body is oval with the cephalic end the larger; the upper and anterior portions of the shell are reticulated with diagonal areas while the lower and posterior are marked by oblique striations. The posterior margin is short, convex and armed with seven or eight sharp teeth, the lower three curving ventrad and the upper three dorsad. The ventral margin of the shell is furnished with pectinate bristles; the antero-ventral curve is armed by short teeth. The head is short and continued into a long proboscis-like beak which is curved anteriad; the eye is large with the crystalline lenses concealed in the pigment. The pigment fleck is much smaller than the eye and situated near the base of the beak; the first pair of antennae is large, thick and gradually tapering distad. The flagellum emerges from the anterior face near the middle. The sensorial hairs are long and coarse, extending nearly as far down as the rostrum. The second pair of antennae is of the usual lynceid form and extends to the level of the ventral margin. The males resemble the females; they are smaller, have a shorter beak, and the post-abdomen resembling that of *P. denticulatus.* The post-abdomen is rectangular, the posterior margin armed with about twenty anal teeth arranged in groups of two, decreasing in size dorsad. The terminal claw is long, curved and armed at the base with two secondary teeth.

Pleuroxus denticulatus Birge

Pleuroxus denticulatus Birge (78:96; Pl. 1, Fig. 21).

Pleuroxus denticulatus Herrick (84:110).

Pleuroxus denticulatus Herrick and Turner (95:256; Pl. 45, Fig. 8; Pl. 63, Figs. 10a, 12, 13).

This species is very much more abundant in the state than *P. procurvus;* in form it is more globose than the latter; the shell is marked by oblique striations; the hairs on the ventral margin are longer and more prominently plumose. The teeth on the antero-ventral curve are not unlike those of *P. procurvus,* while the posterior margin is destitute of teeth, there being three sharp teeth on the postero-ventral margin. The post-abdomen differs from *P. procurvus* only in being less excavated at the distal end. The head is slender and continued into a long, slender beak whose anterior face continues the uniform curve of the dorsal surface. The eye is large and the crystalline lenses differentiated from the pigment in distinction from the concealed lenses in the former species. The first and second pairs of antennae are similar to those of *P. procurvus.* The form agrees in size and other particulars with Birge's description. The material is from Swan Lake.

Pleuroxus truncatus Mueller

Pleuroxus truncata Herrick and Turner (95:258).

This species bears a close resemblance to *P. procurvus,* from which it differs in having the beak straight, the body shorter compared with its height and in having the teeth on the posterior margin of the shell more numerous and all directed posteriad. The sculpturing of the shell is similar to that of *P. procurvus,* so also the fringing of the ventral margin and the presence of teeth on the antero-ventral curve, as well as all other features examined. This species is found in small numbers in Swan Lake.

So far as I can learn, this form has not been previously reported in this country.

Alona glacialis Birge

Alona glacialis Birge (78:106).
Alona glacialis Herrick (84:100).

Female.—The dorsal margin of the shell is markedly convex, reaching its greatest height in the line passing through the middle of the body; the ventral margin is faintly convex in its anterior half, just back of which there is a slight concavity; the posterior margin is rounded. The ventral margin is furnished with hairs which disappear before reaching the ventro-caudal curve. The head is short, the beak short and blunt. The eye is large, the lenses concealed; the pigment fleck is but little smaller than the eye and located nearer the eye than the end of the beak. The first pair of antennae is large, fusiform and extends almost to the end of the beak; the sensorial hairs are few, one of which is much longer than the rest. The second pair of antennae scarcely reaches the lower margin of the shell; the basilar joint is weak and curved dorsad. The dorsal ramus has a sharp spine on the dorsal side of the apical end of the first and third articulation and three apical biarticulate setae; the ventral ramus has an apical thorn on the third articulation and a brush of hairs on the dorso-apical end of the second articulation; this ramus has two lateral and three apical biarticulate setae; the dorsal two of the latter are characterized by spines at the joint. The post-abdomen is rectangular, there being a slight concavity both above and below the short anal tubercle. It is characterized by a double series of anal teeth; the marginal series is arranged in groups of two and decreases in length to the first concavity, where they are replaced by very short, thickly set fine spines. The terminal claw is long and curved back to a point in line with the posterior margin of the post-abdomen. The claw is ornamented by a series of cilia and armed by a single secondary tooth whose length is equal to one-third that of the claw.

The average length is 0.42 mm., height 0.24 mm. This species is abundant in several localities of the state as indicated by the table of distribution; the males are smaller than the females but resemble them very closely.

Graptoleberis testudinaria Fischer

Graptoleberis inermis Birge (78:102; Pl. 1, Fig. 17).

Graptoleberis inermis Herrick (82:250).

Graptoleberis testudinaria Herrick and Turner (95:235; Pl. 65, Figs. 8, 11, 12).

The specimens in my collection agree in general with Fischer's description; the outline is rectangular, the dorsal margin is uniformly curved, not giving the "hump" where the head joins the thorax as described by Fischer. The head is long, representing one-third the length of the valves; it is deep and directed horizontally forward, giving the animal a fishlike appearance. The ventral margin of the shell is but faintly convex and is ornamented by long, densely set hairs. The posterior margin is truncate and without teeth or cilia; the caudo-ventral angle is armed by two stout, sharp teeth that project dorsad. The shell is beautifully reticulated with rectangular areas. The eye is large, the pigment voluminous, entirely concealing the lenses; the pigment fleck is smaller than the eye and is located scarcely half way from the eye to the end of the beak. The ventral margin of the head is convex, the beak blunt and the first pair of antennae short, reaching barely to the lower margin of the head. The sensorial hairs are divergent and about as long as the antenna itself. The second pair of antennae is short and weak; when projected downward they do not reach the level of the lower margin; the rami in my specimens are not as long as indicated by Fischer. There are three apical, biarticulate setae on each ramus and in addition a very short biarticulate seta on the ventro-apical end of the second articulation of the dorsal ramus and a strong spine on the dorso-apical end of the distal joint of the same ramus.

The post-abdomen is slightly fusiform, tapering gradually to the terminal claw, which is seemingly but a continuation of the post-abdomen; the claw is thick and curved distinctly posteriad. Fischer mentions two secondary teeth, but I can find but one very small one in my specimens. The posterior margin of the post-abdomen is destitute of teeth, being ornamented with two series of hairs arranged in tufts. The caudal setae emerge from a common prominent nodule, above which may be seen on the dorsal surface of the abdomen a few scattering hairs in groups of two. The average length of the female is slightly less than indicated by Fischer, being 0.46 to 0.5 mm.; the height averaging only 0.3 mm. The males are somewhat smaller, with the post-abdomen concave on the posterior margin, making the organ continue the curve of the terminal claw. This form is found in small numbers at South Bend and in Swan Lake.

Alonella rostrata Koch

Pleuroxus acutirostris Birge (78:99; Pl. 2, Fig. 15).
Alonella rostrata Herrick and Turner (95:250).

This form agrees so nearly with Koch's description that I do not hesitate to place it under his species; it is very generally distributed over Nebraska as will be seen by glancing at the table of distribution. In outline it resembles *Pleuroxus denticulatus*, but is less oval, the ventral margin being almost straight except in the anterior fourth, which is faintly convex; this margin is fringed with short hairs which are replaced at the posterior end by two to four sharp teeth which point backward. The posterior margin is short, being less than one-half the height of the shell; the dorsal margin is markedly convex, reaching its greatest height in front of the middle line, the curve being continued over the head and beak; the head is very short and the beak long, slender and sharp. The lower portion of the shell is sculptured by striae that run obliquely downward and backward, the upper portion of these are intersected by similar lines that begin anteriad and run obliquely upward and backward, giving this portion of the shell hexagonal areas. The eye is of medium size, the lenses few and not well differentiated from the pigment; the pigment fleck is nearly as large as the eye and located about one-third of the way down from the eye to the end of the beak; the fornices are broad and prominent. The first pair of antennae is long and slender; the second pair is very short and weak, extending but little more than three-fourths of the way from the base to the ventral margin of the valve. The post-abdomen resembles considerably in outline that of *Pleuroxus procurvus;* the posterior margin and the distal end are convex instead of straight as in the latter species. The terminal claw with its two basal secondary teeth are not unlike those of *P. procurvus.* The anal teeth are arranged in twos and decrease in length dorsad. Among the males the post-abdomen is more slender, the anal teeth are replaced by coarse stiff hairs and the secondary teeth are wanting on the terminal claw. My specimens exceed in size those described by Koch. The average length of the female is 0.55 mm., height 0.4 mm. The collections are from Wiley's fish pond near Bellevue, from Stringer's Lake near Wayne, and from Swan Lake, Holt County.

Dunhevedia setiger Birge

Dunhevedia setiger Birge (91:394; Pl. 13, Fig. 20).

Dunhevedia setiger Herrick and Turner (95:237; Pl. 64, Fig. 13).

Dunhevedia seems to be a rare group; it was found by G. O. Sars in 1888 in dried mud from Dunheved and has since been found rarely in this country by Birge, with whose description and figure my specimens agree except in size; average length 0.44 mm., height 0.34 mm., instead of 0.36 mm. and 0.34 mm. as given by Birge. The shell is subquadrate with rounded angles, attaining its greatest height slightly in front of the middle. The dorsal margin is evenly curved, the head is large for a lynceid, the anterior margin continues the uniform curve of the shell, meeting the ventral margin in an obtuse point; the eye is large, approaching the anterior margin of the head, the pigment fleck is much smaller than the eye. A little in front of the ventro-caudal angle there is a single tooth which is more in the form of a curved thorn than a tooth. The ventral margin is slightly concave just in front of this tooth; anterior to this, the margin is nearly straight; the entire free edge, excepting the most anterior part, is fringed with plumose setae. The dorsal margin of the shell and the anterior face of the head are uniformly curved; the shell attains its greatest height near the middle; the posterior margin varies, being truncate in some, in others slightly convex. The shell is marked on the lower portion by longitudinal striae and on the middle and upper by hexagonal areas. The first pair of antennae is large, wedge shaped and completely covered by the fornices; the sensorial hairs are very divergent.

The second pair of antennae is comparatively strong for a member of this family; the basilar articulation of each ramus is as long as the following two. There are three apical, biarticulate, slightly plumose setae on each ramus and in addition two lateral setae on the ventral ramus. The ventral margin meets the posterior in a rounded angle, in front of which is the prominent curved spine already mentioned. The post-abdomen is short, thick, increasing in diameter toward the upper end; the posterior margin is armed on either side by a series of sharp teeth that point dorsad and gradually decrease in length; it is further marked by numerous lateral hairs. The terminal claw is curved, distinctly bent backward and armed by a long, curved secondary tooth; it differs from Birge's description in having on either side a row of cilia in addition to the thorn at the base. Aside from the prominent hook on the first foot, the male resembles the female. The species is rare in Nebraska; I find one occasionally among the collections from Swan Lake.

Chydorus sphaericus Mueller

Chydorus sphaericus Chambers (77:155).

Chydorus sphaericus Birge (78:99; Pl. 2, Fig. 19).

Chydorus sphaericus Herrick and Turner (95:261; Pl. 64, Figs. 4, 7, 8, 10).

This is a very small globose lynceid whose outline varies during the development; the adult presents almost a circle, as viewed from the side; in the younger specimens, the posterior margin is truncate, the dorsal and ventral margins sloping to the posterior margin making obtuse angles. The ventral margin is fringed with short hairs; the head is short and continued into a slender beak which curves backward, preserving the typical spherical outline. The eye is large with a blurred outline; the pigment fleck is about the same size as the eye and situated midway between the eye and the point of the beak. The antennae of the first pair are large, gradually tapering to the apex; the sensorial hairs are few and divergent. The second pair of antennae is short and weak; their weakness in connection with rotund form of the body gives the animal a rolling motion through the water. The basilar joint increases in size from the proximal to the distal end; the first joint of each ramus is long and slender, the dorsal ramus having three apical setae and a sharp spine on the dorso-apical joint. The ventral ramus is provided with three apical setae and also one lateral. The post-abdomen is of the usual lynceid type with the tubercle on the posterior margin emphasized. The posterior margin is rounded at the distal end and armed with ten sharp teeth that decrease dorsad. The terminal claw is slightly curved, ornamented with a row of cilia and armed at the base with a long, curved secondary tooth. The average measurements among the females show a length of 0.4 mm., height 4-5 to 9-10 of the length. Among the males the beak is more blunt, the first foot is provided with a very prominent hook, the post-abdomen is slender and the vas deferens opens in front of the terminal claws. This group is abundant in small lakes near Wayne, also in Betsey's Lake, near Decatur.

Chydorus rugulosus Forbes

Chydorus rugulosus Forbes (90:712).

Chydorus rugulosus Birge (93:308; Pl. 13, Fig. 6).

This species bears such a close resemblance to Forbes' description and figure that I venture to put it under the above title although it does not correspond in all features to *C. rugulosus*. The shell is less spherical than in Forbes' species; I find the size very variable, the average being 0.37 mm. in length and 0.3 mm. in height, considerably less than Forbes' specimens. The valves attain their greatest height in the middle, both the dorsal and ventral margin sloping toward the posterior margin (the dorsal slope being the longer) which they meet in blunt angles; the ventral margin is furnished with spine-like bristles, particularly along the ventro-caudal slope are these spine-like. I find that the valves are characterized by the "dirty rough" appearance mentioned by Forbes. The head is short, the beak slender and hovering close to the valves. In a few animals I found the end of the beak curved slightly forward, a feature observed by Forbes in many of his specimens; the eye is medium in size, the crystalline lenses so concealed that I cannot learn their characters. The pigment fleck is a little smaller than the eye and in most cases triangular in form. It is located not quite half way down from the eye to the beak. The first pair of antennae is less prominent than in the species described by Forbes; the second pair resembles those of *C. sphaericus* in form, but are comparatively larger and stronger; the post-abdomen has a series of anal teeth on either side; the number exceeds that mentioned by Forbes, there being in my specimens 12 to 15.

In other respects my animal resembles *Chydorus rugulosus* Forbes.

This species is generally distributed over Nebraska.

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EXPLANATION OF PLATES

All figures were drawn with aid of a camera lucida; the magnification of each is indicated on the plates.

Plate XXII

Fig. 1. *Bosmina ornamenta*, lateral view of female.

Fig. 2. *Daphnia parvula*, lateral view of female.

Fig. 3. *Daphnia parvula*, eye, showing arrangement of crystalline lenses.

Fig. 4. *Daphnia parvula*, post-abdomen of female.

Fig. 5. *Daphnia curvirostris*, first antenna of male.

Fig. 6. *Simocephalus vetulus*, female, first antenna, showing character of sensorial hairs.

Fig. 7. *Simocephalus vetulus*, postero-ventral margin of carapace, showing character and disposition of teeth on the caudal margin and setae on the postero-ventral margin.

Plate XXIII

Fig. 8. *Moina affinis*, first antenna of male.

Fig. 9. *Diaphanosoma brandtianum*, arrangement of spines on the postero-ventral margin of carapace.

Fig. 10. *Bosmina ornamenta*, post-abdomen of female, showing characteristic ornamentation.

Fig. 11. *Leydigia fimbriata*, lateral view of female.

Fig. 12. *Leydigia fimbriata*, pigment fleck of female.

Fig. 13. *Leydigia fimbriata*, second antenna of female.

Fig. 14. *Leydigia fimbriata*, post-abdomen of female.

Plate XXIV

A map of the soil regions of the state. I am indebted to Dr. Erwin H. Barbour, Professor of Geology in the State University of Nebraska and State Geologist, for the use of this map.

Plate XXV

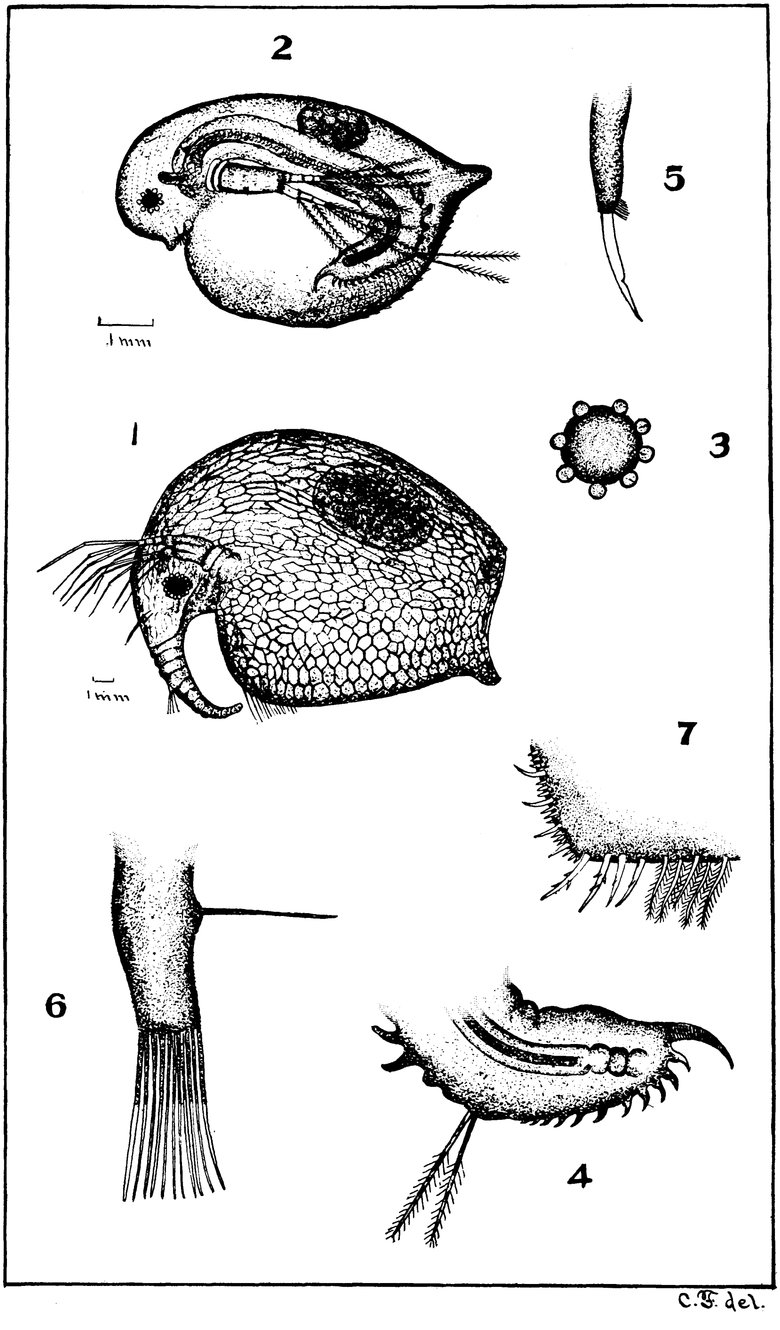
A map with the collecting stations indicated by numbers; at many of the points numbered on the map there are actually several stations. The precise location of the various stations is shown in the table of distribution on pages 132, 133, where the numbers employed agree with those used on this map. The letters in connection with the numbers represent the distribution of the genera.

A indicates Sida.
B indicates Diaphanosoma.
C indicates Daphnia.
E indicates Ceriodaphnia.
F indicates Scapholeberis.
G indicates Simocephalus.
H indicates Moina.
I indicates Bosmina.
J indicates Macrothrix.
K indicates Eurycercus.
L indicates Camptocercus.
M indicates Leydigia.
N indicates Graptoleberis.
O indicates Dunhevedia.
P indicates Alona.
Q indicates Alonella.
R indicates Pleuroxus.
S indicates Chydorus.

Errors in map:

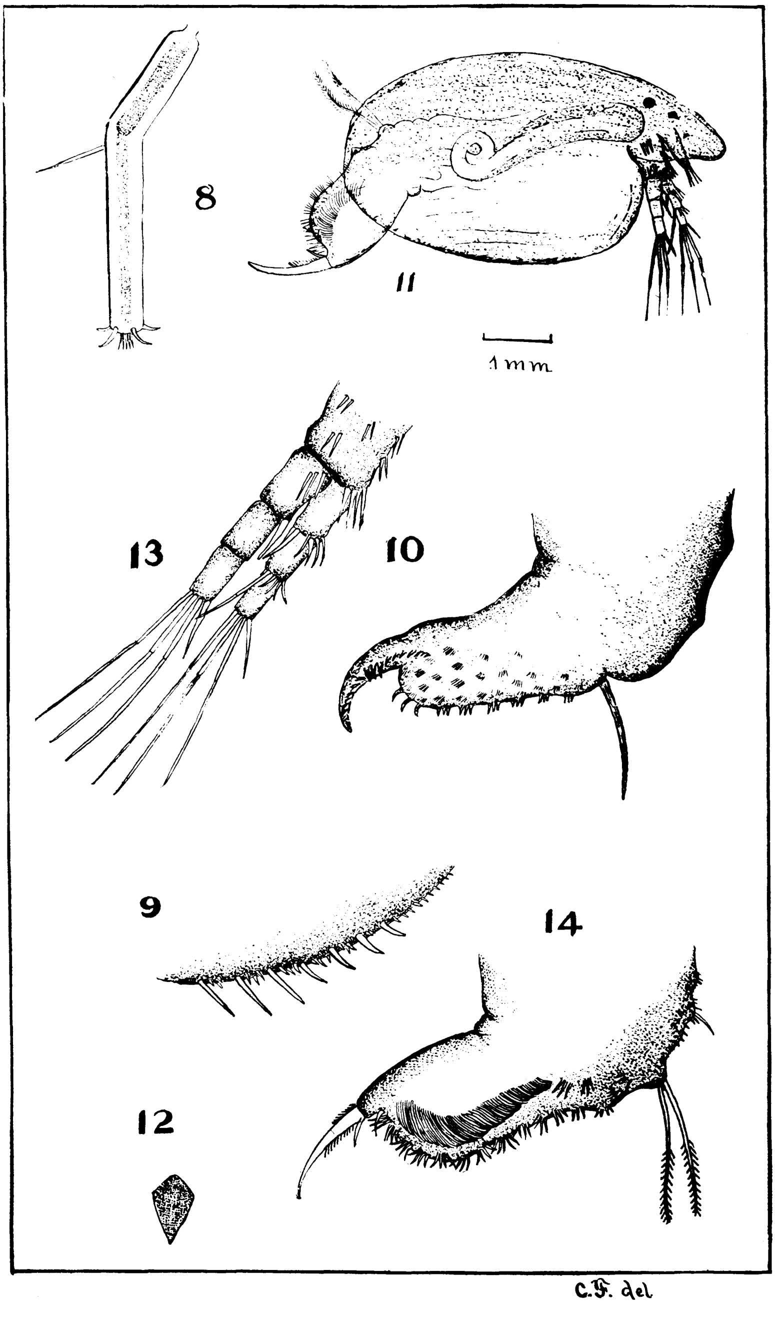
In station No. 2, B and I should be added.
In station No. 10, S should be added.
In station No. 13, C should be added.

PLATE XXII



C.F. del.

PLATE XXIII



C.F. del

PLATE XXIV

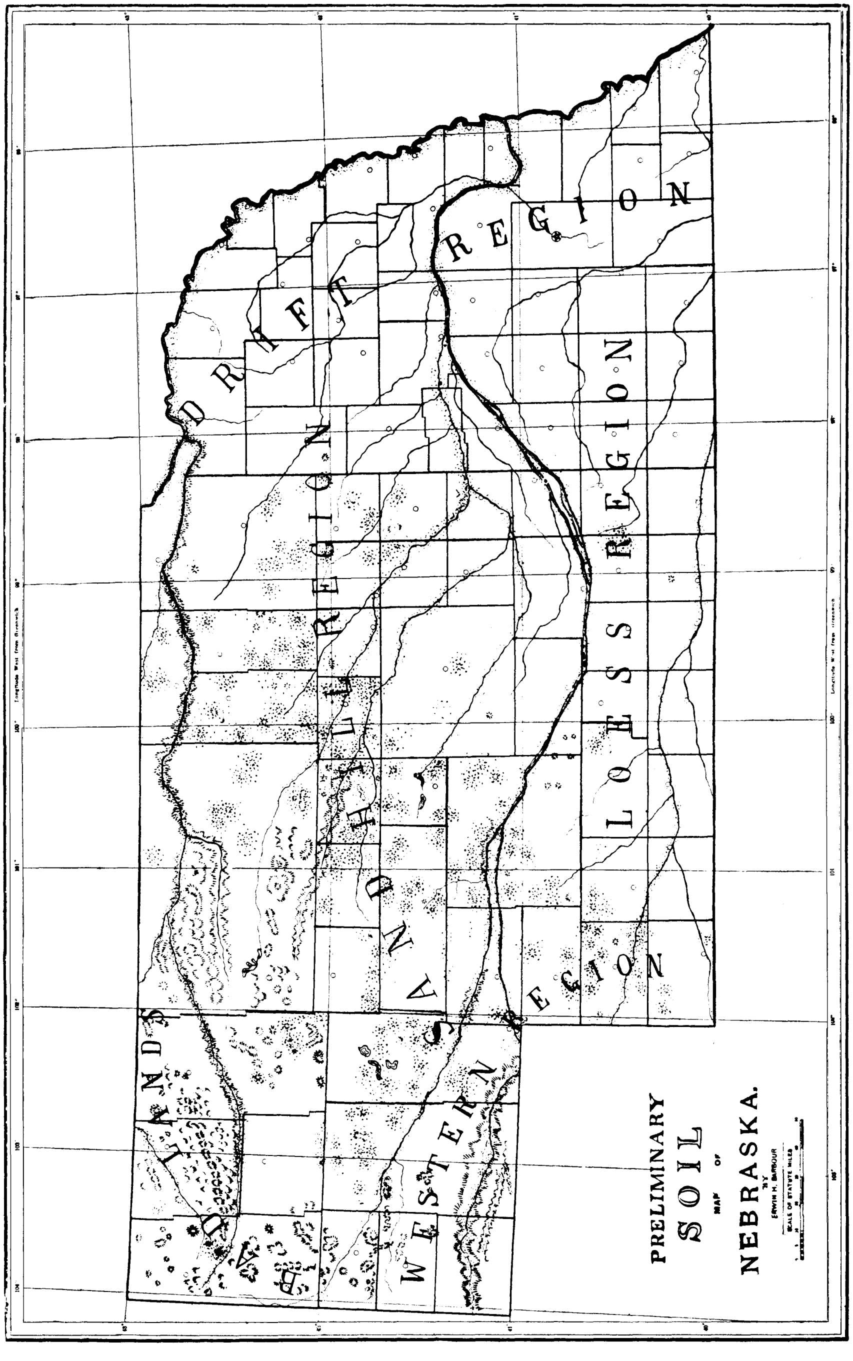
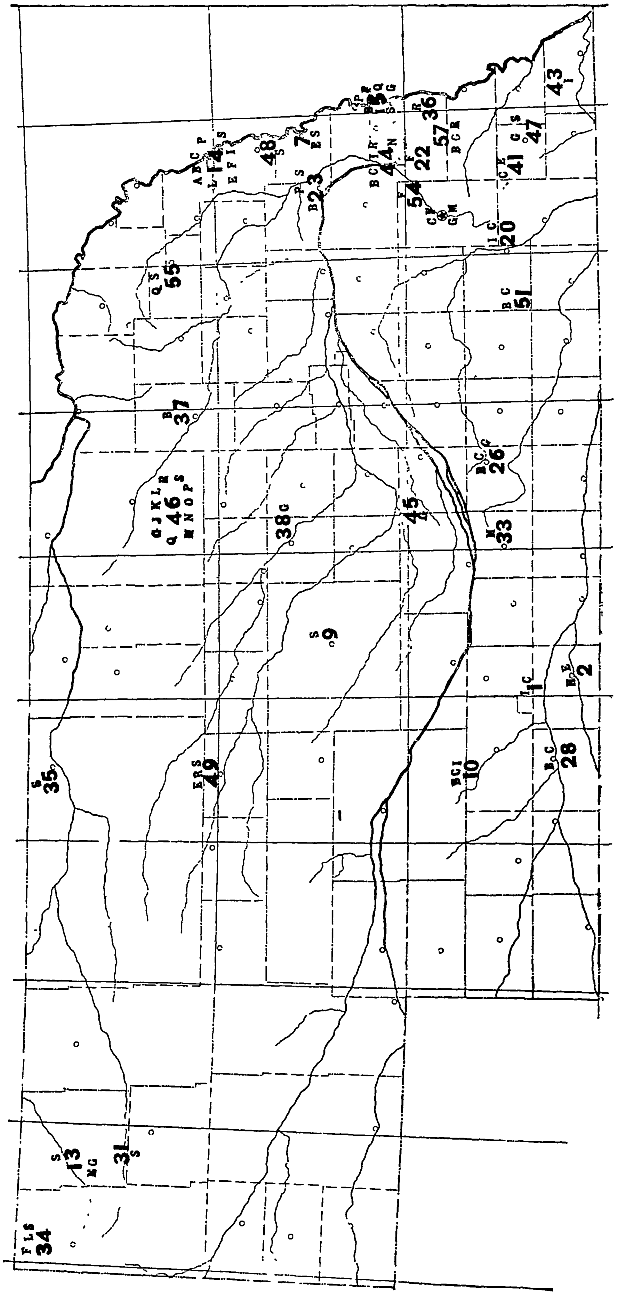

PRELIMINARY
SOIL
MAP OF
NEBRASKA.
BY
ERWIN H. BARBOUR
SCALE OF STATUTE MILES
DRIFT REGION
LOESS REGION
SAND HILL REGION
WESTERN REGION
BAD LANDS
Longitude West from Greenwich

PLATE XXV



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